A

SYSTEM OF MINERALOGY.

A

SYSTEM

OF

MINERALOGY

COMPRISING THE

MOST RECENT DISCOVERI[redacted]

WITH NUMEROUS WOOD CUTS AND FOUR COPPER PLATES

B[redacted]MES [redacted] M.

"Hæc studia nobiscum pe[redacted]inantur, rusticantur"

SECOND EDITION

NEW YORK AND LONDON

PUBLISHED BY WILEY & PUTNAM.

1844.

HITCHCOCK & STAFFORD, PRINTERS,
NEW HAVEN, CONN.

TO

PROFESSOR SILLIMAN,

OF

YALE COLLEGE,

THIS WORK

IS

RESPECTFULLY DEDICATED

PREFACE.

THE seven years that have elapsed since the appearance of the first edition of this work, have witnessed rapid progress in American Geological science. Through the labors of some of our most distinguished men of Science, employed in the various State surveys, the resources of a large part of our country have been developed, and its mines and minerals, as well as its geological formations, largely explored. Chemical analysis, moreover, and crystallographic examination, have been brought to bear upon our Mineralogy; and although we cannot claim a large addition of species, many obscurities have been cleared up, new localities discovered, and the characters and titles of American minerals, to a great extent, ascertained. Sources of information have thus been laid open for making a thorough American work on Mineralogy; and it has been the endeavor of the author to avail himself fully of these various aids, to render, if possible, the present treatise deserving of this title.

In foreign countries, during the same period, the science has made great advances. A large number of new species have been described by its widely spread cultivators, and many doubts with regard to those before known, have been removed or confirmed; while, at the same time, the progress of chemical analysis has given greater accuracy to the formulas for composition. Among the species that have disappeared, the following are the most important: Comptonite, united with Thomsonite; Biotine with Anorthite; Elæolite, Davyne, Cancrinite, and Gieseckite, with Nepheline; Mellilite with Humboldtilite; Junkerite with common Spathic Iron; Levyne, Gmelinite, and Phacolite, with Chabazite; and Gismondine, including Aricite and Zeagonite, with Phillipsite. Others of less interest will be seen by glancing over the work. Many new species will also be observed, and need not be enumerated in this place.

The progress in analysis is especially apparent in the growing interest excited for the natural method of classification, and the opening prospect that, before long, the chemical and natural systems will be identical. There formerly seemed to be no bond of union between the species hornblende, augite, tabular spar, acmite, and manganese spar, and in chemical methods we have found one with the ores of manganese, another with those of iron, another with the salts of lime, and so on; but even Chemistry now suggests the natural system of arrangement, and demands their union in a single family, as given in some of the later chemical treatises. Numerous other instances, stated in the remarks on Classification, illustrate the fact that the natural system is actually founded on chemical principles.

In addition to these developments, we see reason for expecting that the chemical formulas for composition will soon be much simplified. Notwithstanding the well-known principle that crystallizing substances may include, mechanically, the impurities present in a solution, a fact often discoverable with the naked eye, Chemists very generally include in the formula every ingredient obtained by analysis, however small the proportion. In some species, as quartz, lime, heavy spar, celestine, macles of andalusite, auriferous pyrites, and a few others, mechanical mixtures are allowed; but in most cases, especially if the mineral be a complex one, mechanical impurity seems hardly to be thought of as a possibility: while, in truth, the detection of an ingredient, in small quantity, in an opaque crystallized mineral, is neither proof of its mechanical, nor of its chemical combination; and some farther evidence should be required before coming to any conclusion on this point. Had the possibility of mechanical mixtures been more considered, and a doubt indulged when chemistry seemed to clash with crystallography, the science would have been encumbered with fewer synonyms. As an example:—the Peristerite of a British Chemist would have been left in undisturbed union with feldspar. It requires but a common magnifier to detect the impurities (minute spangles, apparently of mica) in the red stripes of this red and white iridescent feldspar from Upper Canada; and it is very probable that quartz may be segregated, on known principles, in the white stripes, like the mica in the red. These facts explain the peculiar composition of this mineral, the analysis of which Rammelsberg quotes with expressions of distrust. If their bearing on the composition of other minerals were admitted, we should find the chemist less hasty in urging forward new species on chemical grounds alone. When we see such mixtures as spongy platina with certain gases, brought to light by chemistry, should we not allow mere cohesive attraction more influence in modifying the composition of crystallizing minerals? And may it not be, that certain compounds, especially those that are isomorphous, are most liable to be taken up in this process.

The natural system adopted in this treatise has received such modifications in the present edition, as were demanded by the advanced state of the science; and the systematic nomenclature has required some corresponding changes.

Besides the natural classification, another, placing the minerals under the principal element in their composition, has been given in part VII, and various improvements on the usual chemical methods have been introduced, which may render it acceptable to those that prefer that mode of arrangement. The Mineralogical Cabinet of Yale College is arranged on this plan.

In connection with the chemical classification, the chemical formulas for composition have been given, according to the latest authorities. Rammelsberg's very valuable treatise on Chemical mineralogy, has been the principal source whence the materials for this part of the work have been derived. The tabular arrangement of these formulas secures many advantages not attained when they are distributed through the volume, each under its species; and by placing them near the close of the work, I have been enabled to introduce the latest corrections.

Besides full accounts of American localities in the body of the work, a catalogue of the same, arranged under the several States in the Union, is appended to the supplement. It includes the more important localities, and the quality of the specimens they afford, as far as ascertained, is indicated. Such a table is convenient for the mineralogical tourist, who may at once learn from it the minerals of the region around him, and ascertain the best route for making collections. This part of the work has been revised by Prof. E. Hitchcock, Dr. C. T. Jackson, and B. Silliman, Jr. for the New England States, Mr. J. A. Clay for the Middle, and Prof. G. Troost and Mr. D. D. Owen for the Western States.

To this edition has been added a chapter on the Irregularities of Crystals, in part from Naumann's elaborate treatise on Crystallography, but illustrated, to a great extent, by American crystallizations. This subject has not hitherto received sufficient attention, as many of the difficulties in the study of crystals arise from such irregularities.

The chapter on Mathematical Crystallography has been omitted, being pressed out by the large amount of other matter, both foreign and domestic, which it became necessary to introduce in bringing the work up to the present advanced state of the science. Should the interest in this important branch of Mineralogy demand it, a separate volume on the subject will be published. A few extra copies of this chapter, on hand, have been bound up with a small portion of the present edition.

The Mineralogical Bibliography has been brought down to the present time, both of Foreign and American works, and of articles in American Journals. Besides exhibiting the progress of the science in our own country, it furnishes the titles of such foreign Treatises and Journals as the student may require in his investigations.

In preparing the present edition of this treatise, I have in general consulted original authorities—the various scientific journals and other publications of Europe and America.

The extensive library of Professor Silliman, to which, with his accustomed liberality, I have been allowed the freest access, has placed at my disposal a very large proportion of the foreign periodicals; and I cannot too gratefully acknowledge these obliging favors.

I mention, also, with much pleasure, the unremitted kindness of Mr. W. G. Lettsom, of the English Legation at Washington, whose library has furnished me with many of the recent journals, and whose advice and aid have contributed much to the observations on foreign species.

The notices of American localities have been re-written throughout, and the facts introduced, gathered in the late Geological Surveys. It was impossible to give authorities after each locality noticed, without swelling the work beyond proper limits; neither is the honor of sufficient moment to require it. Mention has been made of those names to which this branch of American science is particularly indebted, in the remarks introductory to the Catalogue of Mineral Localities. Justice, however, impels me to allude again to the labors of Profs. Shepard, Beck, Emmons, and Hitchcock, and Dr. C. T. Jackson, whose valuable State Reports are rich in information respecting American minerals. The elaborate work

of Prof. Beck has added largely both to the accounts of American localities, and to the knowledge of the crystalline forms of our minerals, besides giving numerous interesting facts on pseudomorphism and mineral physiology. The American Journal of Science, the repository of the scientific labors of our countrymen for the past quarter of a century, as honorable to the country as to its distinguished editors, demands, also, our particular acknowledgments.

I have to mention with gratitude, the generous assistance that has been proffered from every quarter, during the preparation of the work. To Mr. B. Silliman, Jr., am I especially indebted for the varied assistance which he has been enabled to give, through his extensive acquaintance with minerals, analysis, and American science. Much valuable information has been received from Joseph A. Clay, Esq., of Philadelphia, both with regard to American and Foreign species. Possessing, in connection with his brother, J. Randolph Clay, recently American Chargé d'Affaires at Vienna, one of the first cabinets in the country, especially rich in the recent European novelties, his advice has been of essential importance to the work, and the freedom and kindness with which it was given, as grateful to the author. Similar favors have been received from Mr. A. A. Hayes, of Roxbury, Mass., Messrs. Jackson and Teschemacher, of Boston, and Mr. Markoe, of Washington, D. C.; and to Messrs. Hayes and Jackson, the work is indebted for several recent analyses and descriptions of American species. Mr. Markoe kindly allowed me the use of his very splendid collection of minerals, and favored me with many facts of interest.

I would also acknowledge the kind attentions of my friend Mr. Edward C. Herrick, to whom I am indebted for many valuable suggestions.

NEW HAVEN, MARCH, 1844.

CONTENTS.

INTRODUCTION.

PART I.

CRYSTALLOGONY, OR THE SCIENCE OF THE STRUCTURE OF MINERALS.

SECTION I. CRYSTALLOGRAPHY.

PART II.

PHYSICAL PROPERTIES OF MINERALS.

PART III.

CHEMICAL PROPERTIES OF MINERALS.

PART IV.

TAXONOMY.

PART V.

DETERMINATIVE MINERALOGY.

PART VI.

DESCRIPTIVE MINERALOGY.

PART VII.

PART VIII.

PART IX.

ABBREVIATIONS IN NAMES OF AUTHORS.

Berz.	Berzelius.	*J.*	Jameson.
Brews.	Brewster.	*Klap.*	Klaproth.
Beud.	Beudant.	*Linn.*	Linnæus.
Br, Breit.	Breithaupt.	*M.*	Mohs.
H.	Haüy.	*Phil.*	Phillips.
Haid.	Haidinger.	*Thom.*	Thomson
Haus.	Hausmann.	*W.*	Werner.
Hoff.	Hoffman.		

The titles of works or journals given in an abbreviated form in the references through the work, will be found written out in full in the catalogue of Mineralogical works, under Mineralogical Bibliography.

INTRODUCTION.

COMPARATIVE VIEW OF THE NATURAL SCIENCES.

1. The productions of our globe naturally distribute themselves into three grand kingdoms, the Animal, the Vegetable, and the Mineral; and our knowledge of their external characters is comprised in the Natural Sciences, Zoology, Botany, and Mineralogy.

The first two kingdoms include all beings possessed of vitality: beings which increase by an assimilation of nutritive substances, taken internally; which arrive at maturity by a series of successive developments; whose parts are mutually dependent, and cannot be separated without destroying the perfection of the individual; which, after a certain period, lose the capability of continuing the usual functions of life, and consequently die. The powers of vitality being no longer present to counteract decomposition, death is soon followed by a complete destruction of the original living being.

The Mineral kingdom, on the contrary, contains those natural objects that are not possessed of life: objects which increase by accretion merely, or an external addition of particles, unaltered by any powers of assimilation in the object; which are equally perfect in the embryo state or at the earliest commencement of their formation, and in the enlarged individual; whose individuality is not destroyed by a separation of parts; whose formation is originally the result of chemical attraction, and, consequently, they are not, from their nature, necessarily liable to decomposition.

Mineralogy comprises the two distinct, though closely allied sciences, *Mineralogy* proper, and *Geology*. The former considers minerals as independent bodies; the latter, in their dependent relations, constituting soils and various rocks. It is the object of Mineralogy to describe the individual qualities of the several mineral species, while Geology treats of them only as associated in the structure of the earth.

In the following treatise, we shall be occupied only with the former of these sciences. Mineralogy and Geology, however, are so intimately related, that it will be impossible to be complete in

our accounts of minerals, without making some Geological observations.

The term Mineral, as now used, is applied to all *inorganic* natural objects, whether *solid*, *liquid*, or *gaseous*. This signification is much extended beyond its original limits. Some term, however, was required, applicable to *all* inorganic bodies, and the extension of this word is preferred to the coinage of a new one.

MINERALOGY: SUBDIVISIONS OF THE SUBJECT ADOPTED IN THE FOLLOWING TREATISE.

2. There exists in inorganic matter a power called crystallization, or crystallogenic attraction, by the action of which, minerals receive their peculiar forms. This power is analogous to vitality in the animal and vegetable kingdoms, whence arises the variety of structure in plants and animals. Under the head of CRYSTALLOLOGY, or *the Science of the Structure of Minerals*, this subject will occupy Part I. of the following treatise. *Crystallology* includes the two sections; 1. CRYSTALLOGRAPHY, or descriptions of the crystalline forms of minerals; 2. CRYSTALLOGENY, the formation and internal structure of crystals.

We next consider the properties of minerals:—

First, those depending on the *transmission and reflection of Light*, on *Electricity*, *Magnetism*, *Gravity*, *Cohesion*, and also, their relations to the senses of *taste* and *smell*, or their *Taste* and *Odor*. These may be termed the *Physical Properties of Minerals*, and will constitute the subject of Part II.

Second, those properties ascertained by the action of chemical reagents and the blowpipe. These, the *Chemical Properties of Minerals*,* will be considered in Part III.

Taxonomy, or the subjects of *Classification* and *Nomenclature*, will be comprised in Part IV.

Parts V. and VI. will include the classifications of the mineral species, according to methods pointed out in the preceding sections;

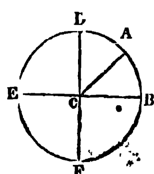
---

* These characters require for their determination a destruction of the individual, and have therefore been rejected by many distinguished mineralogists, who would confine themselves to *Natural History*, or external, characters.

After much examination, with prejudices at the time in favor of the above views, I am fully convinced, that these alone are insufficient for the determination of many mineral species, often so Protean in many of their characters. One instance of this difficulty, from among several which occur to me, is the discrimination between carbonate of strontian, carbonate of barytes, and sulphate of strontian, when their crystalline form is not distinct, and the specimen is so situated, that the specific gravity cannot be determined. Each of these minerals may have a white color, the same hardness, similar lustre; and, in general, all their describable physical properties are the same. It is allowed, that the experienced mineralogist might not perceive any difficulty; but what means has the tyro in the science of distinguishing these three species? None but chemical. A drop of acid decides which is the sulphate, and the application of the blowpipe, by the deep red color of the flame, determines which of the two carbonates contains strontian. Chemical tests, therefore, must of necessity be admitted, among the means of distinguishing minerals.

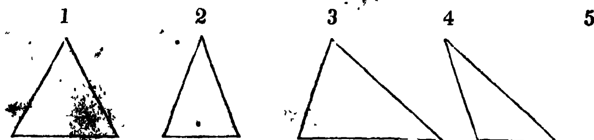
Part V. artificial classifications for the determination of the names of species, under the general head of *Determinative Mineralogy;* Part VI. the natural classification, with full descriptions of the species, under the head of *Descriptive Mineralogy.*

3. In the course of the treatise, a few simple principles in geometry will be introduced, which are here explained.



a. A *plane angle* is the divergence of two straight lines from a given point; as the angle ACB formed by the meeting of AC and BC. If a circle be described, with the angular point C as the centre, and its circumference, BFEDA, be divided into 360 parts, the number of these parts, included between the two lines forming the angle, will be the number of degrees contained by the angle; that is, if 40 of these parts are included between A and B, the angle ACB equals 40°. DF being perpendicular to EB, these lines divide the circumference into four equal parts, and, consequently, the angle DCB equals 360° ÷ 4 equals 90°. This is termed a *right* angle. The size of the angle is independent of the length of the lines DC and BC. An angle more or less than 90 degrees, is termed an *oblique* angle; if less, as ACB, an *acute* angle; if greater, as ACE, an *obtuse* angle.

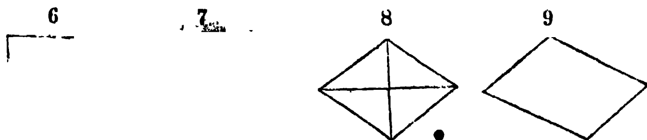
b. The angles ACE and ACB together equal 180°, because the arc BAE, which measures them, is half the circumference. If ACB, therefore, is known, we may find ACE by subtracting ACB from 180°.



c. A *triangle* is a figure bounded by three straight lines. If the sides are equal, the triangle is *equilateral,* (fig. 1:) if two only are equal, it is *isosceles,* (fig. 2:) if all are unequal, *scalene,* (figs. 3, 4:) when all are acute, it is termed an *acute-angled triangle,* (fig. 3:) when there is one obtuse angle, an *obtuse-angled triangle,* (fig. 4.)

If one angle of a triangle is right, it is termed a *right-angled triangle,* (fig. 5.)

d. The sum of the angles in a triangle equals 180°.



e. A *square* is bounded by four equal sides, meeting at right angles, (fig. 6.)

f. A *rectangle* differs from a square in having only its opposite sides equal, (fig. 7.)

g. A *rhomb* is an oblique angled plane figure, contained under equal sides, the opposite of which are parallel, (fig. 8.)

h. A *rhomboid* differs from a rhomb, in having only its opposite sides equal, (fig. 9.)

i. A *diagonal* of either of the above figures is a line connecting the opposite angles; in fig. 8, one is called the longer, the other the shorter diagonal.

k. The sum of the four angles, in either of the above four-sided figures, equals 360°.

l. A *prism* is a solid, bounded by plane surfaces, two of which are called the *bases*, (fig. 50, Pl. I,) and the other faces M, M, the *lateral* planes. Prisms either stand erect on their bases, with the lateral planes perpendicular to the basal, or they are inclined, and have the lateral planes oblique to the basal. The first are called *right prisms*, the second, *oblique prisms*.

m. Octahedrons are bounded by eight triangular faces, (figs. 4, 52, Pl. I.)

n. Dodecahedrons are contained under twelve faces, (fig. 7, Pl. I, and fig. 124, Pl. II.)

o. An *interfacial* angle is the angle contained between two faces of a crystal, and measures their inclination. It is designated by the letters on the faces including the angle, as the interfacial angle M : T, for the inclination of plane M on plane T.

p. A *solid angle* is formed by the meeting of three or more planes or faces of a crystal.

r. Any lines in these solids, connecting similar parts, diagonally opposite, may be called *axes*; for example,—the lines connecting the vertices of opposite solid angles, the centres of opposite edges, or the centres of opposite faces. The particular axes assumed for the purposes of crystallography, will be hereafter stated.

s. Similar faces have their corresponding angles equal.

t. Similar edges are those formed by the meeting of similar faces equally inclined to one another.

u. Similar solid angles are formed by the meeting of the same number of plane angles, equal each to each, and belonging to planes respectively similar.

MINERALOGY.

PART I.

CRYSTALLOLOGY,

OR, THE SCIENCE OF THE STRUCTURE OF MINERALS

SECTION I.

CRYSTALLOGRAPHY.

4. *A crystal is an inorganic solid, bounded by plane surfaces symmetrically arranged, and possessing a homogeneous structure.*

In its original signification, this term was applied only to crystals of quartz, which the ancient philosophers believed to be *water* congealed by a very intense cold. Hence the term, from κρύσταλλος, *ice.** It now includes all those regular solids that owe their formation to the same kind of attraction that produced the κρύσταλλος of the ancients, or which, like that, possess a regular form, whatever may be the color, or the degree of transparency or opacity.

5. In brilliancy of lustre and symmetry of form, crystals, as they are found in nature, sometimes rival the most splendid gems from the hands of the lapidary. They occur of all sizes, from the merest microscopic point, to the diameter of a bushel measure. A single crystal of quartz now at Milan, is *three and a quarter* feet long,

---

* *Diodorus* II 52, p 163, Wess.—τους γαρ κρυσταλλους λιθους ἔχειν την συστασιν ἐξ ὕδατος καθαροῦ παγεντος, ουχ ὑπὸ ψυχους, αλλ' ὑπο θειου πυρος δυναμεως

Seneca, Quæst Nat III 25: "Unde autem fiat ejusmodi lapis apud Græcos ex ipso nomine apparet. Κρυσταλλον enim appellant æque hunc perlucidum lapidem quam illam glaciem ex qua fieri lapis creditur Aqua enim cœlestis minimum in se terreni habens, quum induruit longioris frigoris pertinacia spissatur magis ac magis donec omni aere excluso in se tota compressa, est, et humor qui fuerat, lapis effectus est

Plinius, Hist Nat XXXVII 2 Murrhina—humorem putant sub terra calore densari Contraria huic causa crystallum facit, gelu vehementiore concreto

and *five and a half* in circumference; and its weight is estimated at 870 pounds. One of the gigantic beryls from Acworth, New Hampshire, measures four feet in length, and two and a half in circumference. These large crystals never have the perfection and transparency of those of small size.

Although crystals of the same mineral undergo great variations in size and shape, yet they all conform to a certain system in their modifications. This conformity is so exact, that a mere examination of the inclinations between the planes, is generally sufficient to distinguish the species. It is a fundamental law in crystallography, arising from the perfect symmetry in the arrangement of the planes, that two *corresponding faces, in crystals of the same mineral, give on measurement the same angle of inclination;* and this is true wherever they may be collected, whether in America or the heart of Asia.

It is in consequence of this constancy in the angles of crystals, and a like constancy in their internal structure, that the science of crystallography is of so great importance to the mineralogist. Even a single angle will often suffice to distinguish a mineral.

The forms presented by crystals are all derivable from a few simple solids, which are called *primary forms.* The cube, for example, (figure 1, Plate I,) is one of these primary forms. The cube is *modified,* as the term is used in crystallography, by the addition of planes to the edges or angles, and these planes are called *secondary planes,* and the forms thus produced, *secondary forms.* Thus, in figure 2, Plate I, the plane e, replacing the edge of the cube, is a secondary plane; so also the plane e′, in figure 10, and the plane a, figure 2, or a′, figure 14. The plane P, in the same examples, is a primary plane.

The following are the two fundamental laws in crystallography above explained. The few slight exceptions will be noticed elsewhere.

1. *The same mineral presents uniformly the same primary form as the basis of its crystallization, and when crystallized, exhibits this primary or some secondary to it.*

2. *The primary form of a mineral is invariable in its interfacial angles, and in the interfacial angles of corresponding secondary planes.*

CHAPTER I.

PRIMARY FORMS.

6. The primary forms are fourteen in number, and are either *prisms, octahedrons,* or *dodecahedrons.*

The prisms are either four-sided or six-sided. There is but one six-sided prism in nature. It is called, from its form,

(1.) The Hexagonal prism, (from *Hexagon*, a six-sided figure.)

The four-sided prisms are either right or oblique, and are designated as follows :—

1. *Right Prisms.*

(2.) Cube, (fig. 1, Pl. I.) *Base a square; lateral planes and basal equal.*
(3.) Square prism, (fig. 50.) *Base a square; lateral planes not equal to basal.*
(4.) Rt. rectangular prism. (fig. 69, Pl. II.) *Base a rectangle,* (§ 3, *f*.)
(5.) Right rhombic prism, (fig. 72.) *Base a rhomb,* (§ 3, *g*.)
(6.) Right rhomboidal prism, (fig. 87.) *Base a rhomboid,* (§ 3, *h*.)

2. *Oblique Prisms.*

(7.) Rhombohedron, (figs. 107, 108.) *Base a rhomb; lateral planes and basal equal*
(8.) Oblique rhombic prism, (fig. 91.) *Base a rhomb; lateral planes not equal to basal.*
(9.) Oblique rectangular prism. *Base a rectangle.*
(10.) Oblique rhomboidal prm. (fig. 103 *Base a rhomboid.*

Octahedrons.

The base of an octahedron is a plane passing through four solid angles at right angles with the vertical axis.

(11.) Regular octahedron, (fig. 4, Pl. I.) *Base a square; faces equal equilateral triangles.*
(12.) Square octahedron, (fig. 52, Pl. I.) *Base a square; faces isosceles triangles.*
(13.) Rhom. octahedron, (fig. 76. Pl. II.) *Base a rhomb.*

There is but one primary dodecahedron. This is contained under twelve rhombic faces, and is called

(14.) The rhombic dodecahedron, (fig. 7, Pl. I.)

7. The following are more particular descriptions of these solids. The axes assumed for crystallographic purposes, are three in number, *one vertical* and *two lateral*; excepting in the hexagonal prism and rhombohedron, which have one vertical, and *three lateral.* The vertical axis in the several prisms connects the centres of the bases; the lateral axes connect the centres of opposite lateral faces, or of opposite lateral edges.

a. Cube. The faces of the cube are equal squares. The eight solid angles are similar, (§ 3, *s*, *t*, *u*,) and also the twelve edges. The three axes are equal, and connect the centres of opposite faces.

b. Right Square Prism. The eight solid angles are right angles, and similar, as in the cube. The eight basal edges are similar, ([illegible]), but differ from the four lateral. The axes connect the centres of opposite faces and intersect at right angles. Square prisms may differ in the length of the *vertical* axis, which is hence called the *varying* axis. The *lateral* axes are *equal.*

c. Right Rectangular Prism, (fig. 69, Pl. II.) The sol[illegible]gles are right angles, and consequently similar. There are three kinds or sets of edges: four *lateral*, four *longer basal*, and four *shorter basal*. The axes connect the centres of opposite faces, and intersect at right angles. The three are *unequal*. One of the lateral axes is called the longer or *macrodiagonal*, (from μακρος, *long*,) and the other, the *shorter* lateral axis, or *brachydiagonal*, (from βραχυς, *short*.) The vertical sections through these axes are called, one, the macrodiagonal section; the other, the brachydiagonal section.

d. Right Rhombic Prism, (fig. 72, Pl. II.) The lateral edges are of two kinds; two obtuse (ē) and two acute (ĕ). The solid angles are therefore of two kinds; four obtuse and four acute. The axes are unequal, and cross at right angles. The lateral connect the centres of opposite lateral edges, and one is called the *macrodiagonal*, and the other the *brachydiagonal*, as in the rectangular prism.

e. Right Rhomboidal Prism, (fig. 87.) In right rhomboidal prisms there are two obtuse and two acute lateral edges, and four *longer* and four *shorter* basal edges, (two at each extremity.) The solid angles are of two kinds, four obtuse and four acute. The axes connect the centres of opposite faces; one is oblique, the others cross at right angles.

f. Oblique Rhombic Prism, (fig. 91.) Two of the solid angles, diagonally opposite, consist either of three *obtuse* or three *acute* plane angles, and are called the *dominant* solid angles. If of the former, the prism is oblique from an *obtuse* edge; if of the latter, it is oblique from an *acute* edge. The prism is in position, when on its rhombic base with the dominant solid angle above, in front. The upper and lower solid angles in front are dissimilar, one obtuse and the other acute. The four lateral solid angles are similar. Two of the lateral edges are obtuse (ē,) and two acute (ĕ ;) the same is true of the basal, (ē and ĕ, fig. 91.) The lateral axes are unequal; they connect the centres of opposite lateral edges, and intersect at right angles. The vertical axis is oblique to one lateral axis and perpendicular to the other. The former is therefore called the clinodiagonal, and the latter the orthodiagonal.

g. Oblique Rhomboidal Prism, (fig. 103.) Only the parts diagonally opposite are similar, and consequently there are six kinds of edges, (ē′, ′ē, ĕ′, ′ĕ, and ē, ĕ, fig. 103,) and four kinds of angles, (ā, ă, *a*′, ′*a*.) The axes connect the centres of opposite faces. They are *unequal*, and all their intersections are oblique.

h. Rhombohedron, (figs. 107, 108, Pl. II.) Two of the solid angles diagonally opposite, consist of three *equal obtuse*, or *equal acute*, plane angles, (a, a,) and the diagonal connecting these solid angles is called the *vertical axis*. The solid is in position when this axis is vertical. These angles are called the dominant or vertical solid angles; and when the plane angles composing them are

obtuse, the rhombohedron is called an *obtuse* rhombohedron; if acute, an *acute* rhombohedron. The other solid angles are denominated *lateral* solid angles, and consist in obtuse rhombohedrons, of one obtuse and two acute plane angles; in acute rhombohedrons, of one acute and two obtuse plane angles. The edges that meet at the apex of the vertical solid angle are *terminal* edges; the others, *lateral* edges. The three *lateral* axes are equal, and intersect at angles of 60°; they connect the centres of opposite lateral edges. This will be seen on placing a rhombohedron in position, and looking down upon it from above. The six lateral edges will be found to be arranged around the vertical axis, like the sides of a hexagonal prism.

i. Hexagonal Prism. The angles are twelve in number and similar. The basal edges are twelve and similar; the lateral edges are six in number and similar; M : M=120°. The lateral axes are equal and cross at angles of 60°, connecting the centres of opposite lateral faces, or lateral edges.

k. Regular Octahedron. This solid consists of two equal four-sided pyramids, placed base to base. The six solid angles are similar—so also the edges, which, as in the cube, are *twelve* in number. The plane angles are 60°, and the interfacial 109° 28′ 16″. The axes connect the opposite solid angles: they are equal and intersect at right angles.

l. Square Octahedron. The edges of the base are called the *basal* edges; the others *terminal* edges. The basal section is a square. The vertical sections through the terminal edges are rhombs. The axes are *three* in number and connect opposite solid angles. They intersect at right angles. The vertical is unequal to the lateral, and is called the varying axis. The lateral are equal.

m. Rhombic Octahedron. All the sections in this solid are rhombic. The axes cross at right angles and connect opposite solid angles. They are unequal, and the terms macrodiagonal and brachydiagonal are here used as before explained, (§ 7, *c.*)

n. Rhombic Dodecahedron. The solid angles are of two kinds, *eight* obtuse and *six* acute. The axes are three in number, equal, and connect the apices of the acute solid angles. The plane angles are 109° 28′ 16″ and 70° 31′ 44″, and the interfacial ...

MUTUAL RELATIONS AND CLASSIFICATION OF THE PRIMARY FORMS.

8. In the preceding chapter, *fourteen* primary forms have been enumerated,—or *thirteen*, exclusive of the oblique rectangular prism, which, as it occurs only in an artificial salt, will not be further noticed in this treatise. But many of these thirteen are so related, that the number, for crystallographic purposes, might be reduced to *six*, and the various complex crystallizations may be fully explained by reference to *six fundamental* forms alone.

The subject is thus much simplified These forms are, the *cube*, *square prism*, *right rectangular prism*, *oblique rhombic prism*, *oblique rhomboidal* prism, and *hexagonal* prism, (or *rhombohedron*)

1 The *cube*, *octahedron* and *dodecahedron* are so related that they are often secondaries to one another Galena, the common lead ore, whose primary is the cube, occurs also in octahedrons and dodecahedrons Fluor spar, common salt, &c are other examples. If the angles of a cube be truncated,* and the process of truncation is continued till the primary faces are obliterated, the resulting solid is the regular octahedron. Figures 1, 2, 3, and 4. Plate I, illustrate this transition, the planes a (fig. 2) truncate the angles of the cube, enlarged, they produce the form in figure 3, and by still farther enlargement, the octahedron represented in figure 4 In a similar manner, the dodecahedron proceeds from a cube by the truncation of its edges In figure 5, the planes e truncate these edges, in figure 6, the edges are further removed and e enlarged, in figure 7, the primary planes are obliterated by the extension of e and the resulting solid is a dodecahedron. It is obvious that a cube may proceed in as simple a manner from an octahedron or a dodecahedron Compare figure 4 with figure 3— the octahedron with the angles truncated by planes P—, figure 2— the same more deeply so— and figure 1, the resulting cube The dodecahedron in figure 6, has its *acute solid angles* truncated, in figure 5 more deeply truncated, from which, the transition is next to the cube itself, figure 1 The relation of the octahedron and dodecahedron may be seen by comparing figures 7, 8, 9, 10, in which the octahedron is shown to proceed from the dodecahedron by the truncation of its obtuse solid angles, and the latter, from the octahedron by the truncation of its edges.

---

* In the remarks on this subject, the following technical terms are employed to avoid circumlocutions

Replacement An edge or angle is *replaced*, when cut off by one or more secondary planes

Truncation An edge or angle is *truncated*, when the replacing plane is equally inclined to the adjacent faces (fig 2, a, and 5, e)

Bevelment An edge is *bevelled*, when replaced by two planes, which are respectively inclined at equal angles to the adjacent faces, (fig 10, e′) This term may be applied to an angle when replaced by three planes, each inclined at the same angle, to its adjacent face (fig [illegible]) Truncation and bevelment can only occur on edges or angles formed by the meeting of equal planes

Planes on an edge, have their intersections with the adjoining faces, parallel to the edge The intersections of e e fig 10 are parallel to the original edge

Planes on an angle, intersect the basal face parallel to its diagonal The intersection of a, with the basal P, (fig 2 or 51,) is parallel to the diagonal of P

Intermediary planes intersect the basal faces parallel neither to the diagonal nor to an edge, but have an intermediary situation Such are planes o, o, (figs. 24 and 58)

The facts stated in this and the following paragraphs, would be more thoroughly impressed on the mind of the student, if he should perform the dissections here described, with some convenient material, as chalk, raw potatoes, wax, or wood By thus actually deriving one form from another, the mutual relations of the primary forms will be easily understood. Chalk is, for many reasons, preferable for this purpose When the models are finished, their surfaces may be rendered quite hard, by covering them with a solution of gum or varnish

These solids are similar in their axes, as above explained. They are three in number, equal and intersect at right angles. It will be remembered that the centres of the faces of the cube are the apices of the solid angles of the derived octahedron, or of the acute solid angles of the derived dodecahedron.

2. The *square prism* and *square octahedron* have the same mutual relation as the cube and regular octahedron; the transition from one to the other is shown in figures 50, 51, and 52. The axes of the square prism and octahedron are alike. There is one varying axis—the other two are equal, and all cross at right angles.

3. The *rhombic prism, rectangular prism*, and *rhombic octahedron*, are often secondaries to one another. The replacement of the lateral edges of a rectangular prism (planes *e*, figures 70, 71,) when extended to the obliteration of $\bar{M}$ and $\breve{M}$, produces a rhombic prism, (figure 72.) The same is shown in figure 73; also the converse, that the truncation of the lateral edges of a rhombic prism will afford a rectangular prism. Compare also, figs. 72, 71, 70 and 69. The passage of the rhombic prism to a rhombic octahedron arises from the replacement of the basal edges of the prism, as is shown in figures 72, 75, 76: the faces of the octahedron are the planes e of figure 75. This octahedron proceeds from the *rectangular* prism by a replacement of the angles. Compare figures 69, 74, 76.

The axes of these three solids are alike. They are *unequal*, and intersect at right angles.

4. The *oblique rhombic* and *right rhomboidal* prisms are correlative forms. As is shown in figure 92, an oblique rhombic prism may be obtained by replacing the edges *e*, *e*, of the rhomboidal; and conversely the rhomboidal is obtained by truncating the lateral edges of the rhombic prism. This relation is also apparent from figures 89, 90, 91. In these figures the rhomboidal prism does not stand on its rhomboidal base, but on one of the other faces. Figures 87 and 88, and figures 89 and 90, are the same solids in the two different positions. In figures 87 and 89, the prism stands on its rhomboidal base. The lettering of the figures shows their corresponding parts.

In these solids the axes are unequal; two cross at right angles; the other (the vertical) is oblique to one of the lateral, (the clinodiagonal) and at right angles with the other lateral, (the orthodiagonal.)

5. The *oblique rhomboidal* prism stands alone, unrelated to either of the other primaries.

6. The *hexagonal prism* and *rhombohedron* are often secondaries of one another. Calc spar is a familiar example. In figures 109 and 110, the rhombohedron passes into a prism by the truncation of its lateral edges; and in figures 111 and 112, the same is shown to take place by the replacement of its lateral solid angles. The truncation of the terminal solid angle of the rhombohedron

produces the terminal plane, (as seen in figures 112, 113, 114, and completes the prism. The change of a hexagonal prism to a rhombohedron is produced by replacing similarly, three alternate basal edges at one extremity of the prism, and the three alternate with these, at the other.

The axes of the hexagonal prism and rhombohedron, are four in number: the vertical is at right angles with the lateral; the lateral are equal, and intersect at angles of 60°.

9. From this review of the primary forms, it appears that there are only six distinct systems of crystallization, as follows:

1. The *monometric*, (μονος, *one*, and μετρον, *measure*;—axes, of one kind,)—includes the cube, octahedron and dodecahedron.

2. The *dimetric*, (δις, *two fold*, and μετρον, *measure*;)—includes the square prism and square octahedron.

3. The *trimetric*, (τρις, *three-fold*, and μετρον;)—includes the rhombic and rectangular prisms and rhombic octahedron.

4. The *monoclinate*, (μονος, *one*, and κλινω, *to incline*;—one inclined axes;) includes the oblique rhombic and right rhomboidal prisms.

5. The *triclinate*, (τρις and κλινω;—the three axes all obliquely inclined,) includes the oblique rhomboidal prism.

6. The *hexagonal*; includes the hexagonal prism and rhombohedron.*

CLEAVAGE.

10. It is a fact of common observation, that the mineral called mica, (sometimes, improperly, isinglass,) is easily split into thin transparent plates or laminæ. This is often effected with but little more difficulty than separating the leaves of a book, and at once suggests the idea, that, like a book, this mineral may be composed of a great number of closely applied leaves. This property of mica depends on its crystallization, and the process of separation is termed *cleavage*. Galena is another instance of a mineral capable of easy cleavage. It differs from mica, however, in having *three* cleavage directions at right angles with one another. This mineral, therefore, instead of splitting into thin plates, breaks into small *cubes*. Calcareous spar also admits of easy cleavage, but yields rhombohedrons. The directions, in which a crystal

* Other names used for these systems are the following:—1. Tesseral, tessular, *Mohs*—Isometric, *Haumann*.—2. Pyramidal, *Mohs*—tetragonal, *Naumann*—monodimetric, *Hausmann*.—3. Prismatic, *Mohs*—rhombic and anisometric, *Naumann*—trimetric, *Hausmann*.—4. Hemi-prismatric, *Mohs*—monoclinohedral, *Naumann*—clino-rhombic, *Kobell*.—5. Tetarto-prismatic, *Mohs*—triclinohedral, *Naumann*—clino-rhomboidal, *Kobell*.—6. Rhombohedral, *Mohs*—hexagonal, *Naumann*—monotrimetric, *Hausmann*. The oblique rectangular prism constitutes the *diclinate* system—or the diclinohedral of *Naumann*.

cleavage, are termed *natural joints*, and the slices obtained, are called *laminæ*.

The facility with which cleavage may be obtained, is very unequal in different minerals. In some instances, as in the first above cited, the laminæ are separable by the fingers. In others, a slight blow of the hammer is sufficient; others require the application of a sharp-cutting instrument, and often some considerable skill in its use. When other means fail, it may sometimes be effected by heating the mineral and plunging it, when hot, into cold water. Attempts of this kind are sometimes effectual with quartz. In many instances, cleavage cannot be effected by any means, owing to the strong cohesion of the laminæ. In these cases, however, the direction of cleavage is sometimes indicated by lines on the surface. It is often important to observe these lines when cleavage is possible, in order to determine its direction before applying the knife.

When cleavage is easily obtained, it is said to be *eminent*.

11. The general laws, with respect to cleavage, are as follows:

1. Cleavage, when attainable, takes place parallel to some or all of the faces of a primary form.

2. Cleavage is obtained with equal ease or difficulty, parallel to *similar* primary faces, and with unequal ease or difficulty, parallel to *dissimilar* primary faces.

3. Cleavage, parallel to similar planes, affords planes of similar lustre and appearance, and the *converse*.

According to the first law, if a cube is cleavable, cleavage will either take place parallel to the faces of the same, in which case the primary form is a cube, or on the angles, when the primary is an octahedron, or on the edges, when it will produce a dodecahedron. Cubes of fluor spar may be very readily reduced to the primary octahedron by cleavage. This is a very convenient material for the exercise of the student, who needs but his knife to succeed in effecting the cleavage.

According to the second law, cleavage is obtained with equal ease parallel to all the faces of a cube, octahedron, dodecahedron, or rhombohedron, which solids are contained under equal planes. The right square prism, right rhombic prism, and oblique rhombic prism, may be cleaved with equal ease or difficulty, parallel to their lateral planes, since these are similar. Often, however, no cleavage can be effected in these prisms, except parallel to the bases, and, in many instances, not even in this direction. The right rectangular, right rhomboidal, and oblique rhomboidal prisms, have unequal cleavage in the three directions; and according to the third law, the cleavage in the three directions will produce faces of unlike lustre and general appearance. This is exemplified in gypsum; in one direction, it is cleavable with great facility into thin laminæ of perfect transparency, and highly polished surfaces; in a second direction, the crystalline laminæ first bend and then break, exhibiting a surface which is not smooth, nor possessed of much lustre;

in the third direction, it is brittle, and breaks immediately on attempting to bend it, affording a surface smoother than the second, but not polished In thick masses, the second and third cleavages are scarcely attainable. Two of these cleavages incline at an oblique angle, but are at right angles with the third; the primary form is, therefore, a right rhomboidal prism.

Rhombic prisms, in addition to a rhombic cleavage, sometimes admit of cleavage parallel with one or both diagonals—that is, parallel with the lateral faces of a rectangular prism.

ISOMORPHISM

12. In the early stages of mineralogical and chemical science, identity of crystalline form was supposed to indicate an identity of chemical composition As facts multiplied, the truth of this law was soon doubted, and in 1817, its uncertainty was well illustrated by Beudant in an article tending to prove the superiority of crystallographic characters for the distinction of mineral species. The law, however, by which the variations in the composition of the same species, were governed, was not fully understood till 1819, when Mitscherlich brought out the fact that certain substances may replace one another in the constitution of compounds, without varying the crystalline form This property he called *Isomorphism*, from ἴσος, *equal*, and μορφή, *form*, and those bases that admitted of mutual substitution, were termed *isomorphous* By referring to the analyses of pyroxene or garnet, a remarkable disagreement will be observed between the several varieties of each, arising from the isomorphous nature of magnesia, lime, and oxyd of iron. In some specimens one of these bases is replaced wholly by both or one of the others; and often all three are found combined, and sometimes oxyd of manganese is also added

There are several groups of isomorphous bodies laid down in chemical works, to which I would refer for a knowledge of them The following are of most frequent influence, in the constitution of minerals 1 *Alumina, peroxyd of iron*, and *peroxyd of manganese*.—2 *Lime, magnesia, protoxyds of iron, manganese*, and *zinc*.—3. *Baryta, strontia, oxyd of lead*.—4. *Sulphur, selenium, tellurium*.—5. *Tungsten, molybdenum*.—6. *Phosphoric acid*, and *arsenic acid*.

13 The identity in the crystallization of isomorphous compounds is not usually exact, and the term plesiomorphous, (from πλησίος, *near*, and μορφή) which has been proposed, is unobjectionable. The following is a list of the principal groups of plesiomorphous minerals, compiled from Kobell's and Kopp's tables.

1. Arragonite, strontianite, Witherite, carbonate of lead.

2. Calc spar, Dolomite, carbonate of magnesia, mesitine, ankerite, carbonate of iron, carbonate of manganese, and carbonate of zinc

3. Heavy spar, celestine, sulphate of lead.
4. Apatite, green and brown lead ore.
5. Epsom salt, and white vitriol.
6. Potash-alum, soda-alum, ammonia-alum, and magnesia-alum.
7. Carbonate of soda and carbonate of silver.
8. Crystallized sulphates of zinc, magnesia, and nickel.
9. Crystallized sulphates of copper and manganese.
10. Albite, Andesine.
11. Diopside, diallage, augite, Hedenbergite, red manganese spar, Bustamite, and probably also tabular spar and Boltonite.
12. Scolecite, mesolite, and perhaps also natrolite.
13. Corundum, red iron ore.
14. Spinel, automolite, Franklinite, magnetic iron, chromic iron.
15. Tungstate of lime, tungstate of lead, molybdate of lead.
16. Rutile and Tin ore.
17. Light red silver ore and dark red silver ore.
18. Olivenite and Libethenite.
19. Fahlerz and silberfahlerz.
20. Uranite and chalcolite.
21. Pyromorphite, polysphærite, mimetene, hedyphane, and apatite.
22. Nickel glance, nickel stibine, and cobaltine.
23. Smaltine and white nickel.
24. Tennantite and black copper.
25. Antimony glance and orpiment.
26. Galena, Clausthalite, cobaltic galena, selenid of lead and mercury.
27. Tellurium, antimony, arsenic.
28. Gold, silver, copper, amalgam.
29. Copper nickel and antimonial nickel.
30. Iridosmine, magnetic pyrites, (Breithaup.)

DIMORPHISM.

14. Certain compounds have two distinct systems of crystallization, and they assume the one or the other, according to the circumstances under which they crystallize. This property is called dimorphism, from δις, *two*, and μορφη, *form*. Carbonate of lime is one of these dimorphous substances, presenting either rhombohedrons, as in calc spar, or rhombic prisms, as in arragonite. The peculiar crystallization of arragonite was at first imputed to the strontia detected in it; but it has been found that some specimens do not contain a trace of this or any other impurity, and are as pure a carbonate of lime, as calc spar. The late discovery of other compounds possessing the same peculiarity, has established the fact, that this property, called dimorphism, belongs to the unadulterated compound. Carbonate of iron is dimorphous like carbonate of lime, as will be seen by reference to the species spathic iron and Junkerite, (carbonate of iron.) Barytocalcite and Bromlite

are also dimorphous. In each of these carbonates, one of the forms is oblique and the other right rhombic. Sulphuret of iron, (iron pyrites and white iron pyrites,) sulphur, sulphate of magnesia, sulphate of iron, sulphate of zinc, biphosphate of soda, and arsenous acid, are other compounds in which this property has been observed.

The physical characters of a compound often vary with the system of crystallization. In arragonite the hardness is 3·5—4, and specific gravity 2·92—2·94, while in calc spar, the hardness is 3, and the specific gravity 2·52—2·73.

CHAPTER II.

SECONDARY FORMS.

LAWS FOR THE OCCURRENCE OF SECONDARY PLANES.

15. The number of secondary forms which the six systems of primary forms are capable of affording, is exceedingly large; at least many millions, supposing them to be of invariable dimensions. But as most of these primaries may vary their dimensions infinitely, the possible number of varieties of form is infinite.

Secondary planes do not occur indiscriminately on a crystal, but are governed by the following simple law:

All the similar parts of a crystal are similarly and simultaneously modified; or, by the subordinate law,

Half the similar parts of a crystal may be similarly modified, independently of the other half.

The operation of the second, or subordinate law, produces *hemihedral* forms of crystals, or forms with half the number of secondary planes that perfect regularity would require. The forms resulting from the first law, are termed *holohedral* forms, from ὅλος, *all*, and ἕδρα, *face*.

16. *Monometric System.* According to the first law, if a single edge of a cube, octahedron, or dodecahedron, be truncated, all will be simultaneously truncated, for all are similar, ([illegible]; fig. 5, Plate I.) If an edge of the same be replaced by a plane inclined unequally on two adjacent faces, to retain the symmetry according to the above law, a second plane must occur on this edge similar to the first, as is represented in fig. 10. This becomes evident, when we consider that these planes occupy similar parts of the crystal, and agreeably to the above law, all similar parts must be simultaneously modified. This is termed, as stated in the note to § [illegible]element. It also follows, that all the edges of these solids will be similarly beveled.

Again, the truncation of *one* angle of a cube is necessarily accompanied by the truncation of *all*, (fig. 2.) If a plane, situated as a′,

in fig. 14, occur on an angle of this solid, three similar planes *may*, and therefore *must*, occur on the same angle, one inclining on each face. In addition, similar planes will occur on *all* the angles. So, in the octahedron, we find four planes, (a′, figure 17,) on each angle, one inclined on each face.

If an intermediary plane, (fig. 24,) is situated on the angle of a cube, it will be accompanied by five others, or there will be six in all, and forty-eight in the whole solid, (fig. 24.) The possibility of the occurrence of six similar planes, is sufficient to *require* their occurrence, since the number of similar parts about the angle is therefore six. It should be observed, that two of these six planes may be said to belong to each edge. Thus, two to the edge P : P′, two to the edge P′ : P″, and that they correspond to bevelments of the same edges. This correspondence may be seen by comparing figs. 24 and 10.

For the same reason, there will be eight intermediary planes on each angle of the octahedron, two for each of the edges. It is manifest, that if one of these intermediary planes should be dropped, the symmetry of the crystal would be destroyed.

The angles of the dodecahedron being of two kinds, (§ 7, *n*,) they will be independently modified. The modifications are the same as in the cube and octahedron, (Plate I, figures 6, 8, 13, 18, 27.)

b. The exceptions arising from the second law, are not of unfrequent occurrence. They are of two kinds: either,

1. *Half the similar angles, or edges, are modified independently of the other half*; or,

2. *All the similar angles, or edges, are modified, but by half the regular number of planes.*

Figs. 28, 33, are examples of the first kind of *hemihedrism*, in which half the angles of the cube are modified, while the remaining half are unmodified.

Fig. 42 is an instance of the second kind. All the edges are similarly replaced, but by one of the two beveling planes represented in fig. 10. The plane e′ is enlarged in fig. 43. From this last figure, it will be observed, that the suppressed planes are those which were alternate, and that two planes e′, incline on each face, P. The crystals have therefore a symmetrical character.

Another instance may be observed in fig. 48, in which each angle of the cube is replaced by three out of the six intermediaries in fig. 24; thereby half the number of planes which perfect regularity would [illegible].

The *first* species of hemihedrism gives rise to solids, whose opposite planes are not parallel; a face of a tetrahedron, for example, has no opposite parallel face. The same is true of all solids resulting from this kind of replacement, and arises from the fact, that opposite parts of the crystal producing these forms, as, for instance, the diagonally opposite angles in figs. 28 and 33, are not similarly

modified. Hemihedral crystals of this kind have been called *inclined hemihedrons*, for the above reason, that opposite planes are not parallel, but inclined to one another.

On the contrary, according to the *second* species of hemihedrism, the opposite parts of a crystal are similarly replaced, and, consequently, the hemihedrons proceeding from this replacement have their opposite faces parallel. Such is the case in figs. 43 and 48. These solids have been termed *parallel hemihedrons*.

The same mineral never presents both of these species of hemihedrons. The former occurs in boracite, the latter in iron pyrites, and many other species. It is also important to observe, that minerals, whose crystals are hemihedrally modified, are invariably thus modified, if the secondary planes occur, in which the hemihedrism may take place. We may illustrate this statement by a reference, first, to the species iron pyrites, whose modifications follow the second of the above laws. The cubes of this species never occur with beveled or truncated edges, but, (whenever the edges are modified.) are invariably replaced by planes *unequally* inclined to the adjacent faces. Again, the angles are never replaced by *six* intermediaries, but by *three alternate*, as in fig. 48, o. In *boracite*, we observe, that invariably only one half of the angles are similarly replaced, and that the modified angles present all the planes required by the regular law for secondary planes. The edges of the cube are not affected by this species of hemihedrism, as it influences only the replacements of the angles.

17. *Dimetric System.* The modifications of the basal and lateral edges of a square prism, take place independently, owing to their dissimilarity, (§ 7, *b*.) The lateral edges are included by equal planes, and, therefore, are invariably either truncated or beveled, (figs. 61, 62.) The basal edges are similarly replaced; but being the intersections of unequal planes, they are never truncated or beveled. A plane on these edges, therefore, inclines unequally on the adjacent faces, (fig. 53.)

For the same reason, the angles cannot be truncated. A plane on an angle, however, inclines equally to the two lateral planes M, M, in consequence of the equality of these planes, (fig. 51.)

The similar intermediary planes can be but two in number. The *two* which incline on the base, are unlike those inclining on the lateral planes, because the base and lateral planes are dissimilar. These intermediary planes are represented in fig. 58.

The peculiarities in the modifications of the square octahedron, are easily deduced from its relation to the prism, and, moreover, are determined without difficulty from the nature of the solid itself.

18. *Trimetric System.* The edges of the right rectangular prism are of three kinds, and those of each kind are, according to the above law, independently modified, (figs. 70, 77, 78, 79.) Moreover, none of them can be truncated or beveled, in consequence of the inequality of their including planes.

Planes on the angles incline *unequally* on the three adjacent, *unequal* planes. The angles are similar, and therefore will be modified simultaneously, (fig. 74.)

This prism can have but one intermediary of a kind on each angle. This follows from the inequality of the three edges that meet at each angle.

The lateral edges of the right rhombic prism admit of truncation and bevelment, because of the equality of the lateral planes. The obtuse are, however, modified independently of the acute, (fig. 84.) The obtuse solid angles, and the acute, are also independent in their modifications. Each may have two intermediary planes, (fig. 85.) The replacements of the basal edges are similar and simultaneous, (fig. 75.)

19. *Monoclinate System.* In the oblique rhombic prism, only the opposite of the lateral edges are similarly replaced; they may be truncated or beveled, (fig. 100.) The *front superior* basal edges are unlike the *front inferior*, or the *superior behind*, (§ 7, *f*,) and are therefore modified independently of the latter, (fig. 101.)

The four lateral solid angles are composed of the same number of plane angles, which are equal each to each, and belong to planes that are respectively equal. Their modifications, consequently, are similar, (fig. 98.) The front angles are dissimilar, and independent in their modifications, (figs. 96, 97.)

The right rhomboidal prism, unlike the right rhombic, cannot have its lateral edges truncated or beveled. Its basal edges and angles are dissimilarly modified. Placed on a rectangular face for its base, as in fig. 88, we may apply to it the same remark as above. The *front superior basal* edge and angles, being unlike the *front inferior* or *superior behind*, they are modified independently of the latter. This is the most simple method of viewing this solid.

20. *Triclinate System.* In the oblique rhomboidal prism, there can be neither truncations nor bevelments. Only *diagonally opposite* parts are similarly modified, and, consequently, similar adjacent or proximate planes cannot exist. (By *approximate* planes are understood those, not opposite, which are separated by one or more planes.) The front superior basal edges are unlike in their modifications, and also unlike those of the front inferior basal. The same is the fact with the angles, (figs. 104, 105, 106.) The only similar plane to *a*, in the solid, (fig. 104,) is its diagonally opposite. So with other planes.

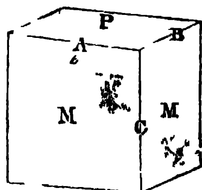
21. *Hexagonal System.* The vertical solid angles of the rhombohedron are formed by the meeting of three equal planes, and equal plane angles. These angles may, therefore, be truncated, (fig. 113,) or replaced by three or six similar planes. The edges, for a similar reason, may be either *truncated*, or *beveled*. The terminal edges, however, are replaced independently of the lateral, (figs. 109, 115, 117, 119.)

The lateral angles, six in number, are replaced simultaneously, (figs. 111, 121.) Two intermediary planes may occur on each, (fig. 118.)

The similar parts in the rhombohedron and hexagonal prism being three, or some multiple of three, (excepting the vertical solid angles,) the similar secondary planes are also three, or some multiple of three.

22. Notwithstanding the regularity in the secondary forms of crystals, resulting from the preceding laws for the occurrence of secondary planes, Crystallography would scarcely be entitled to its rank as a science, were it not for the existence of a second law. It is this second law which gives to the science a mathematical basis. It is as follows:—

The ratio of the edges removed by secondary planes is a simple ratio.



In removing the edge A, to produce the plane *e*, parts of the edges B and C are also removed. If then B and C are equal, as in the cube, the parts of B and C removed, according to the above law, will either be equal, (a truncation,) or there will be twice as much of one removed as of the other, or three times as much, and so on; that is, the ratio of the parts will be either 1 : 1, 1 : 2, 1 : 3, and also, sometimes, 1 : 4, 2 . 3, 3 : 4. Other ratios sometimes occur, but are uncommon. If B and C are unequal, the ratios will be the same, excepting, that the parts of B and C removed, will be proportional to the lengths of their edges; that is, the ratios will be 1 B : 1 C, or 1 B : 2 C, or 1 B : 3 C, or it may be, 2 B : 1 C, or 3 B : 1 C, also, 2 B : 3 C, or 3 B : 2 C. The last expression signifies a ratio of three times the length of B to twice the length of C; or, if the edge B, be divided into a certain number of equal parts, and C into the same number, the plane, whose ratio is 3 B : 2 C, cuts off three parts of B, and two of those of C. The figures are used in the same manner in the preceding expressions.

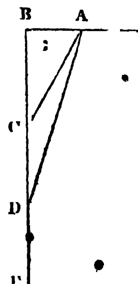
A plane on an angle, (A, B, C, again being equal,) may either cut off A, B, C, in the ratio of 1 : 1 : 1, that is, equal parts from each, or in the ratio of 1 : 1 : 2, the figures referring to the letters in the order just given; or, again, as 1 : 1 : 3, 1 : 1 : $\frac{1}{2}$, 1 : 1 : $\frac{1}{3}$, or 1 : 1 : $\frac{1}{4}$, in which the part cut from C is only one fourth that cut from either A or B. So also, there may occur the ratio 1 : 1 : $\frac{2}{3}$, 1 : 1 : $\frac{3}{4}$. Others are of occasional occurrence. If A, B, and C, are unequal, the first ratio above, that is, the ratio of equality, becomes 1 A : 1 B : 1 C; and the others, 1 A : 1 B : 2 C, 1 A : 1 B : 3 C, 1 A : 1 B : $\frac{1}{2}$ C, 1 A : 1 B : $\frac{1}{3}$ C, 1 A : 1 B : $\frac{1}{4}$ C, &c. Planes *on angles* have an equal ratio of A and B, as is observed in the above examples.

Intermediary planes cut off unequal parts of the three edges, A,

B, C. Some of the occurring ratios are 4 : 2 : 1, 6 : 3 : 2, that is, if these edges are divided into the same number of equal parts, the plane, whose ratio is 4 : 2 : 1, is formed by removing 4 of the parts on edge A, 2 on edge B, and 1 on C.

23. It has been stated, that on these principles depends the application of mathematics to this science.

A few hints on the mode of applying plane trigonometry in the study of crystals, will be of use to the student.



Let AC be a plane on the edge of a crystal:

Given EAC *to find* ACD.

If EBD is a right angle, subtract EAC from 270° and the remainder equals ACD.

If EBD is an oblique angle, subtract EAC from 180° and add EBD to the difference, and the sum will be the angle ACD.

Given EAC *to determine the ratio of* AB, *to* BC, *or the height and breadth of the prism.*

EAC subtracted from 180° gives the angle BAD. Then in the right angled triangle ABC, the angles are given to find the ratio of the sides, which is determined by working the proportion R : BA :: tan. BAC : BC, or if BA=1, BC equals tan. BAC.

If the triangle ABC is oblique, and the angles are known as before, we may obtain the ratio by the proportion sin. ACB : AB :: sin. BAC : BC, and if AB=1, BC=sin. BAC÷sin. ACB. The same equation holds good also for rectangular crystals.

In the above, we have supposed the plane AC to be that having the simple ratio of 1 : 1, or 1 A : 1 B. If this be not the case, then, as explained, the results obtained will be some simple multiple of the true ratio between the edges or axes.

Given BA *and* BC, *to determine the interfacial angle* EAC *or* FCA.

This is determined by reversing the above proportion, as follows: BA : R :: BC : tan. BAC. If BA=1, which may be assumed, then BC=tan. BAC. If the plane AC has the simple ratio 1 A : 1 B, then the result gives the relative height and breadth of the prism; or if it equals 1 A : 2 B, then it gives the ratio between the height and double the breadth, and so on.

We leave this subject with these few remarks. The principles of analytical geometry afford a more convenient mode of calculation, and one of more general application, for which the student is referred to the former edition of this work.

DERIVATION OF SECONDARY FORMS FROM THE PRIMARIES.

25. When treating of the primary solids, a few of their secondary forms were pointed out. The octahedron was shown to be derivable from the cube by the truncation of its solid angles, and

conversely, the latter from the former, by a truncation of the angles of the octahedron. In a similar manner, the dodecahedron has been shown to proceed from the cube, by a truncation of the edges of the latter, &c. (See § 8.)

We propose to continue this subject, as a perfect acquaintance with derivative forms is of the utmost importance to the mineralogist. We again treat of the several forms, according to the classes to which they belong.

1. *Monometric System.*

The *holohedral* and *hemihedral* forms may be separately considered.

26. *Holohedral Forms.*

a. Tetrahexahedron. A bevelment of the edges of a cube is represented in fig. 10, and the result of a continuation of the process in fig. 11. This form is bounded by twenty-four triangular faces. The above name indicates its general resemblance to the cube or hexahedron, at the same time that it expresses the number of its faces. It is derived from τετρακις, *four times*, ἕξ, *six*, and ἕδρα, *face*; the 4×6-faced solid.

The planes *a* in fig. 12, which are observed to replace the solid angles of the octahedron inclining at the same time on its edges, if extended to the obliteration of the primary faces, produce the same form as above, (fig. 11.) The replacement of the *six* acute solid angles of the dodecahedron by *four* planes resting on the primaries, (fig. 13,) if continued, results in the same solid.

By varying the angle of the bevelment of the cube, tetrahexahedrons of different angles may be produced. Those of most common occurrence have the following angles:

Interfacial Angles.

	A	C*	
1. =	133° 48′ 47″	157° 22′ 4″	
2.	143° 7′ 48″	143° 7′ 48″	occurs in garnet.
3.	154° 9′ 29″	126° 52′ 12″	" fluor spar.

Plane Angles.

	a	c	
1. =	50° 14′ 16″	79° 31′ 28″	
2.	48° 11′ 23″	83° 37′ 14″	occurs in garnet.
3.	46° 30′ 30½″	86° 58′ 59″	" fluor spar.

b. Trisoctahedrons. The angles of the cube are represented replaced by three planes in figs. 14 and 19; in one, they incline on the primary faces, in the other, on the edges of the cube. The completed forms obtained by these replacements, are seen in figs. 16

* The letters designating the angles refer to the figure, Pl. I. C is, however, substituted for 2 C. The same is the case in the following forms. According to the system of crystallographic notation, these solids are designated, ∞ O $\frac{3}{2}$; ∞ O 2; ∞ O 3

and 20. Fig. 15 is an intermediate form between 14 and 16. The resulting solids, though considerably unlike, have a general resemblance to octahedrons, with a three-sided pyramid substituted for each octahedral face. Like the octahedron, they are formed on the angles of the cube by a replacement by three planes instead of one, which accounts for their general resemblance to this solid The name, Trisoctahedron, is derived from τρις, *three times*, 'οκτω, *eight*, and ἑδρα, *face*, 3×8-faced solid. The faces of one of these solids are four-sided, or *tetragonal*, those of the other, three-sided, or *trigonal*; they are, therefore, distinguished by the names *tetragonal trisoctahedron*, and *trigonal trisoctahedron* The more common name of the former is *trapezohedron*.

The *tetragonal trisoctahedron* (fig. 16) may be derived from the octahedron, by replacing its angles by four planes *inclining on its faces*, (fig. 17,) and from the dodecahedron, by a truncation of its *twenty-four* edges, (fig. 18)

The *trigonal trisoctahedron* proceeds from the octahedron, by beveling its *twelve* edges, (compare figs. 21 and 20 ;) and from the dodecahedron, by a replacement of its six acute solid angles by four planes inclining on the edges

The tetragonal trisoctahedron, or trapezohedron of most common occurrence, has the following angles.

B=131° 48′ 37′, C=146° 26′ 34″. Fig. 16.
a=82° 15′ 3″, *b*=117° 2′ 8″, *c*=78° 27′ 46″ Ex. leucite and garnet.

A trigonal trisoctahedron, (fig. 20,) occurring in fluor spar and galena, has the following angles :

A=152° 44′ 2″, B=141° 3′ 27″, *b*=118° 4′ 10″, *c*=30° 57′ 55″.*

c. Hexoctahedron. Fig. 24 represents a cube, with six planes on each angle, and, consequently, forty-eight in all. The resulting solid is completed in fig. 25. Here, for each face of the octahedron, is substituted a low six-sided pyramid. The name of this solid is derived from the Greek, ἑξακις, *six times*, 'οκτω, *eight*, and ἑδρα, *face*, the 6×8-faced solid.

A replacement of the angles of the octahedron by eight planes, produces a similar solid, (fig. 26.) A bevelment of the *twenty-four* edges of the dodecahedron, (fig. 27,) also necessarily produces a *forty-eight*-faced solid. Others, differing in their angles, may result from a replacement of the *six* acute solid angles of the dodecahedron, by *eight* planes, or the *eight* obtuse by *six* planes.

Two occurring varieties have the following interfacial and plane angles :

---

* The crystallographic expressions for these trisoctahedrons are, for the tetragonal, 2 O 2, for the trigonal, 2 O.

1. A=158° 12′ 48″, B=148° 59′ 50″, C=158° 12′ 48″, garnet.
2. " 162° 14′ 50″, " 154° 47′ 28″, " 144° 2′ 58″, fluor spar.
1. a= 86° 56′ 25″, b= 56° 15′ 4″, c= 36° 48′ 31″.
2. 35° 50′ 23″, 54° 21′ 34″, 39° 48′ 3″.*

27. *Hemihedral forms.*

a. Hemi-Octahedron, or *Tetrahedron.* If half the angles of the cube are replaced by a single plane, as in fig. 28, the resulting form is a tetrahedron, or hemi-octahedron, (figs. 29, 30.) The same may arise from an octahedron, by an extension of one half of its faces, to the obliteration of the other half. This process is represented as partially completed in fig. 32.

Its plane angles are 60°, and its interfacial angles, 70° 31′ 44.″

b. Hemi-Trisoctahedrons. Fig. 33 represents a cube, with its alternate angles replaced by three planes. The planes in this figure, when occurring on all the angles, give rise to the tetragonal trisoctahedron, (fig. 16); occurring on but half, they produce the solid in fig. 34.

The secondary planes in fig. 19, occurring on but half of the angles, and enlarged, form the solid in fig. 40, which is a hemihedral form of the trigonal trisoctahedron. Its faces are *tetragonal,* and, therefore, if a name be desirable, it may be termed the *tetragonal hemi-trisoctahedron.*

The former has *trigonal* faces, and is called the *trigonal hemi-trisoctahedron.*

A crystal of gray copper ore has the following angles:

B=109° 28′ 16″, C=146° 26′ 33″.
a=31° 28′ 56″, b=117° 2′ 8″.†

c. Hemi-Hexoctahedrons. A solid of this kind is represented in fig. 41. It is formed by a replacement of half the angles of the cube, by six planes, similar to those in fig. 24.

If *all* the solid angles of the cube be replaced by *three* alternate planes, out of *six* intermediaries, a hemihedral solid is formed, which is represented in fig. 49. It differs from the above, in having parallel opposite faces, and is, therefore, a *parallel hemi-hexoctahedron.*

A variety of inclined hemi-hexoctahedron, having the following angles, has been observed in boracite:

A=162° 14′ 50″, B=124° 51′ C=144° 2′ 58″.‡
a= 40° 19′ 7″, b= 54° 21′ 34″, c= 85° 19′ 7″.

d. Hemi-Tetrahexahedron, or *Pentagonal Dodecahedron.* A cube is represented in fig. 42, with but one of the two beveling planes on each edge given in fig. 10. The same enlarged, is observed in fig. 43. Fig. 44 represents the completed solid. The second of the above names is commonly applied to this solid.

* The crystallographic symbols are as follows: 3 O $\frac{3}{2}$, 4 O 2.

† Its crystallographic symbol is $\frac{2O2}{2}$. ‡ The crystallographic symbol is $\frac{4O2}{2}$.

Figs. 45, 46, exhibit the planes on the octahedron, which, extended, give rise to this solid, (figs. 47, 44.)

Two forms of this kind have been observed in iron pyrites:

1. A=112° 37′ 12″, C=117° 29′ 11″,
a=102° 35′ 40″, b=108° 24′ 30″, c=110° 17′ 40″.
2. A=126° 52′ 12″; C=113° 34′ 41″,
c=121° 35′ 18″, b=106° 36′ 2″, c=102° 36′ 19″.*

2. *Dimetric System.*

28. *Holohedral Forms.*

The derivation of an octahedron from a right square prism, by a replacement of its solid angles by a single plane each, has already been explained. By different inclinations of this plane, different octahedrons may be obtained.

The basal edges of this solid are eight in number, and similar, and, consequently, by their replacement at different angles, may give rise to another series of octahedrons, (figs. 53, 54.)

Two intermediate planes on each angle of the prism, (fig. 58,) produce, if extended, a double eight-sided pyramid, (fig. 59.) A square prism, diagonal with the primary, may be obtained by truncating its lateral edges, (fig. 61,) and an eight-sided prism by beveling the same, (fig. 62.)

b. Hemihedral Forms.

A few hemihedral forms, appertaining to this class, are represented in figs. 63, 66, 67. The first is an irregular tetrahedron, and is formed in a similar manner with the monometric tetrahedron. The second is the complement of the solid represented in fig. 67.

3. *Trimetric System.*

29. A replacement of the lateral edges of a right rectangular prism, has been stated to give rise to a rhombic prism. If the edges ē, (fig. 67,) are replaced, as in fig. 78, or the edges ẽ, as in fig. 77, prisms will also be formed, which, from their horizontal position, are called *horizontal prisms*, (fig. 79.)

4. *Hexagonal System.*

30. The derivation of two six-sided prisms from the rhombohedron, has been fully explained in § 8, *b*; the one by a truncation of the six lateral edges, (figs. 109, 110;) the other, by a replacement of the six lateral angles, (figs. 111, 112,) by planes parallel to the vertical axis.

The remaining parts of the primary faces on the first of the above

* The signs of these solids are, $\frac{[\infty O \frac{3}{2}]}{2}$, and $\frac{[\infty O 2]}{2}$

prisms, are rhombic, (fig. 110;) those on the second, are pentagonal, (fig. 112.) This is an important distinction.

In fig. 115, the lateral edges of the rhombohedron are beveled; a greater extension of these secondary planes produces the solid represented in fig. 116, which is called the *scalene dodecahedron*, since its faces are scalene triangles, and twelve in number.

A bevelment of the terminal edges (fig. 117) continued, gives rise to a similar solid. A replacement of the lateral angles, by two intermediary planes, (fig. 118,) produces other solids of the same kind.

A truncation of the terminal edges of the rhombohedron, is observed in fig. 119. Since these edges are six in number, three at one end of the crystal, alternating with three at the other, the solid formed by the extension of these planes, must be an oblique solid, contained under six equal faces, or, in a word, a rhombohedron, (fig. 120; example, *lenticular calc spar.*) It is much more obtuse than the primary. Moreover, because the lateral angles are six, and three alternate are nearer the lower extremity of the axis, and the remaining three nearer the upper extremity, the planes (*a*, *a′*) on these angles, if not parallel to the vertical axis, incline alternately above and below, (fig. 121;) and, therefore, by their extension, will give rise to rhombohedrons, (fig. 122, and fig. 2 under *Calc spar.*) These rhombohedrons will differ in the lengths of their vertical axes, as these planes vary their inclination. The nearer they approach to parallelism to the vertical axis, the longer the axis of the rhombohedron; and the six-sided prism, formed on these angles may be considered a rhombohedron, with an infinite axis.

An isosceles dodecahedron, (fig. 124,) so called, because its faces are isosceles triangles, may be obtained from a rhombohedron, by a replacement of the lateral angles, provided this replacement is carried so far that the remaining primary faces (fig. 124) just equal the secondaries produced by the replacement. In figure 124, the alternate faces R, R, are primary, and the remainder, secondary. Such is the origin of the pyramidal termination of crystals of quartz. This solid may also be formed by replacing the basal edges or angles of the hexahedral prism, (e, fig. 125.)

Two intermediary planes on each angle of a hexagonal prism, produce, by their extension, a twenty-four-sided figure, formed of two twelve-sided pyramids placed base to base. This solid is represented in fig. 126.

Hemihedral forms often occur in the Hexagonal system, but usually in connection with holohedral. Under tourmaline, (fig. 3,) is represented a six-sided prism of this mineral, differently terminated at its two extremities. The secondary faces *a′*, *a′*, at the upper extremity, replace the lateral angles; the secondary faces, e, e, e, at the lower, truncate the terminal edges; the three planes *a*, *a*, which truncate the alternate edges of the six-sided prism, replace the alternate lateral angles. The six lateral planes (*e*) which compose the hexagonal prism in this mineral, are formed on the six lateral *edges*, (not on the an-

gles.) We arrive at this conclusion, by observing, that the faces R, if the planes a' were removed, would be *rhombic* and *not pentagonal.**

A triangular prism, a hemihedral form of the hexagonal prism, is of frequent occurrence in crystals of tourmaline.

On Lettering Figures of Crystals.

31. Some difficulty is occasionally experienced by the young mineralogist in *reading* the figures of crystals, or, in other words, in determining the particular situation of each secondary plane. Much aid may be derived from a simple system of *notation*, in which letters on the planes shall designate the edge or angle on which these planes are situated. The following system is proposed for this purpose:

In applying the following principles, a few of the primary forms are supposed to have a certain position.

The right rhombic prism should be placed with an obtuse lateral edge towards the observer: the right rhomboidal, (except for the lettering of its primary planes,) on its rectangular base, as in fig. 88; the oblique rhombic and rhomboidal prisms, with the dominant solid angle in front; it is immaterial whether at the inferior or superior base. Farther than this, no attention need be paid to the situation of these solids.

The primary planes of prisms, when alike, as in the cube, are lettered P; if unlike, the letter P is retained for the basal, and M used for the lateral planes; and, finally, if the lateral are unlike, the larger lateral is lettered M, the smaller T, except in the right rectangular prism, whose larger lateral plane is lettered $\bar{M}$, and the smaller $\breve{M}$, (see figs. 69, 87.) The primary faces of the rhombohedron will be lettered R; those of the octahedron A; those of the rhombic dodecahedron E; the reason for using these letters will be seen farther on. (See figs. 3, 4, 7, 107.)

* The relations of secondary forms to their primaries, is beautifully exhibited by means of glass models. They may be made from common window or plate glass, by cutting the glass in the form of the faces of the solid to be made, and then uniting them by means of glue. The author has generally found it convenient to glue a small cord between two adjacent pieces of glass, as the adhesion between the glass and the cord, by means of glue, is much stronger than between two pieces of glass. The forms thus far finished, may be rendered much firmer, and, at the same time, the glue and cord concealed, by covering the edges with narrow strips of paper, cut for the purpose; colored glazed paper is preferable, as it is less easily soiled. The primaries, when completed, may be placed within the secondary, which afterwards can be closed up, and its edges papered. In this way, a primary may be inclosed within any of its secondaries, and the relations of the two solids, is at once apparent. The plane angles of the faces in the monometric solids, are given in the preceding pages, by laying off which, a plane figure may be drawn, having the form of the desired face; by then placing the plate of glass over the figure, it may be cut with a diamond and a rule. Good glue is necessary to produce the cohesion of the glass; gum arabic suffices for attaching the slips of paper to the edges

In general, the letter e may be applied to planes on the edges, a, to planes on the angles, and o, to intermediaries.

If the basal edges differ from the lateral, as in the prisms, the Roman e may be retained for the basal, and the italic *e* for the lateral.

If any of the edges are oblique, we may distinguish the *obtuse* by the mark —, the *acute* by the mark ⌣, and thus may have ē, ĕ, for planes on the obtuse and acute basal edges in the oblique prisms, (fig. 91,) *ē*, *ĕ*, for planes on the obtuse and acute lateral edges. In the right rhomboidal prism, the front superior basal edge is obtuse, ē, the inferior acute ĕ, while the lateral are rectangular, and are therefore lettered e, simply. (See fig. 88.) In rectangular prisms, the longer basal edge may be marked ē and the shorter ĕ.

In the oblique rhomboidal prisms, there are two unlike obtuse basal edges, and two unlike acute. We may letter planes on the edge to the right hand, ē′, or ĕ′, on that to the left, ′ē or ′ĕ.

If the front angles differ from the lateral, as in the rhombic and rhomboidal prisms, we may retain the Roman a for the front, and employ the Italic *a* for the lateral, (fig. 72.)

If the front angles at the two bases differ, as in the oblique prism, the planes on the obtuse may be distinguished by ā, those on the acute by ă, (figs. 96, 97.)

In the rhombohedron, the vertical solid angle may be lettered a, the lateral *a*; the terminal edges e, the lateral *e*.

All the monometric solids will be hereafter lettered, as if derived from the cube. In the other classes, the lettering will depend on the primary.

The changes of the letter o for intermediaries, and the use of the marks — and ⌣, will follow the same changes as the letter a: that is, intermediary planes about the angle ā, will be lettered ō, those about the angle *a*, *o*.

The different planes on the same edge or angle, may be distinguished by indices, as follows: a′, a″, a‴, a^4, a^5, &c.

The main principles in this system of notation are:

1. Lettering planes on edges, e, on angles, a, and intermediaries, o.

2. Distinguishing planes on the basal edges from those on the lateral, by lettering the former with a Roman e, and the latter with an italic *e*.

3. Distinguishing planes on *obtuse* edges from those on *acute*, or longer basal edges from the shorter, by placing the mark —, over the letter for the former, and ⌣, for the latter, as ē, ĕ, *ē*, *ĕ*.

4. Distinguishing planes on the frontal angles from those on the lateral, by lettering the former with a Roman a, the latter with an italic *a*.

5. Distinguishing planes on obtuse frontal solid angles from those on acute, by the mark —, over the letter for the former, and ⌣, for the latter.

CHAPTER III.

IRREGULARITIES OF CRYSTALS.

32. The laws of crystallization, when unmodified by external causes, produce forms of exact symmetry; the angles are not only equal, but also the polygonal faces of crystals and their several dimensions. This symmetric harmony is however so uncommon, that it can scarcely be considered other than an ideal perfection. Crystals are very generally distorted, and often the fundamental form is so completely disguised, that an intimate familiarity with the possible irregularities is required, in order to unravel their complexities.

The irregularities of crystals may be treated of under four heads:* 1. *Imperfections of surface*; 2. *Variations of form and dimensions*; 3. *Internal imperfections and impurities*; 4. *Pseudomorphous crystallizations.*

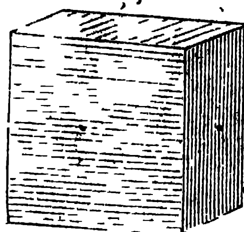
1. IMPERFECTIONS IN THE SURFACES OF CRYSTALS.

1. *Striated Surfaces.*

33. The parallel furrows on the surfaces of crystals are called *striæ*, and such surfaces are said to be *striated.*

Each little ridge on a striated surface is enclosed by two narrow planes more or less regular. These planes often correspond in position to the secondary or primary planes of the crystal, and we may suppose these ridges to have been formed by a continued oscillation in the operation of the causes that give rise, when acting uninterruptedly, to enlarged planes. By this means, the surfaces of a crystal are marked in parallel lines, with a succession of narrow planes meeting at an angle and constituting the ridges referred to. This combination of different planes in the formation of a surface has been termed the *oscillatory combination.* The horizontal striæ on prismatic crystals of quartz, (fig. 23, p. 51,) are examples of this combination, in which the oscillation has taken place between the prismatic and pyramidal planes. As the crystals lengthened, there was apparently a continual effort to assume the terminal pyramidal planes, which effort was interruptedly overcome by a strong tendency to an increase in the length of the prism. In this manner, crystals of quartz are often tapered to a point, without the usual pyramidal terminations.

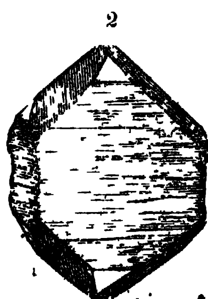
* Many of the following facts, with the general arrangement of them, are extracted from Naumann's work on Crystallography



Iron Pyrites.

Cubes of *pyrites* are generally striated, in such a way that the striæ on adjacent faces are at right angles with one another, as in the accompanying figure. These lines are parallel to the intersections of the primary surfaces with the planes of a pentagonal dodecahedron, (fig. 43 and 44, Pl. I,) the most common secondary of pyrites; and they have evidently resulted from an oscillation between the primary and this secondary.

Diagonal striæ sometimes occur on the faces of a cube showing an oscillatory combination between the cube and octahedron. The rhombic dodecahedron is often striated parallel either with the *longer* or the *shorter* diagonal of its faces; the *former* resulting from an oscillatory combination of the dodecahedron with the regular octahedron, and the *latter*, with the cube or planes beveling the edges of the cube, as in *Aplome*. The accompanying figure represents a distorted crystal of magnetic iron from Haddam, Ct., illustrating the oscillation between the octahedron and dodecahedron. The faces of trapezohedral garnets are often striated parallel with the symmetrical diagonal, showing an oscillation with the dodecahedron.



Magnetic Iron.

Rhombohedrons of chabazite and red silver ore are often striated parallel to the terminal edges, indicating an oscillatory combination between the primary faces and a secondary plane replacing these edges.

Prisms of tourmaline are very commonly bounded by three convex surfaces, owing to an oscillatory combination of the planes *u* and *e*, (figures 2 and 3 under *Tourmaline.*)

34. It is obvious that the irregularities described, must sometimes affect the angle of inclination between planes. The interfacial angle of a rhombic prism are thus made more obtuse, being sometimes increased 15 or 20 degrees, and occasionally, as just stated, the angles are lost in a curved surface. This can lead to no important error, since the striations generally show that the faces are not simple planes. Tremolite, Sillimanite, Tourmaline, &c., are examples.

35. The striations on the lateral surfaces of foliated minerals like mica and gypsum, are merely the edges of laminæ.

The interposition of foreign substances in parallel lines also produces striations. Brewster attributes to this source the parallel diagonal lines in some rhombohedral crystals of calc spar.

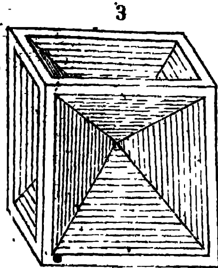
Besides striations, the surfaces of crystals are sometimes formed of minute crystals; such are the faces of octahedral crystals of fluor,

consisting of minute cubes. Angular markings are also often observed, as on quartz crystals, beryls, &c., indicating the internal structure of the crystal.

2. *Cavernous Crystals.*

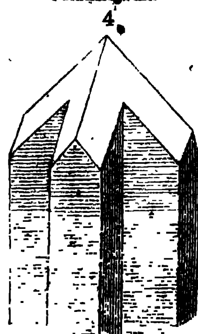
36. Crystals not unfrequently occur with a deep pyramidal depression occupying the place of each plane, as is often observed in common salt, alum, and sulphur. The annexed figure represents a cavernous cube of salt. In the solution of crystals, the same form is sometimes obtained, owing to the fact that the centres of the faces yield sooner than the edges and angles. A remarkable cavernous crystal of pyrites, from Almerode, described by Hausmann, is represented in the annexed figure. It is an elongated cube with its upper edges replaced by faces of the dodecahedron; but instead of a corresponding replacement of the lateral, a deep rectangular channel occupies the place of each. It resembles a cruciform crystal of Harmotome; but the striations show that it is not compound.

3



Common Salt.

4



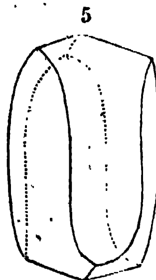
Pyrites; Almerode.

3. *Curved Surfaces.*

37. Curved surfaces resulting from what is termed oscillatory combination, have already been noticed. Other curvatures proceed from a curvature in the laminæ constituting the crystal. Crystals of diamond have convex faces, and they are sometimes almost spheres. (Fig. 18, page 49, is an example of this fact.) This mode of curvature in which all the faces are equally convex, is less common than that in which a convex surface is opposite and parallel to a corresponding concave surface. Rhombohedrons of spathic iron and pearl spar are usually thus curved, as is shown in figure 2 of *spathic iron.* The saddle shaped crystals of the same mineral (fig. 1) are remarkable instances of several curvatures in the same face.

A singular curvature is shown in the accompanying figure of white iron pyrites. The conical crystals of brown zinc blende and the lenticular and conical crystals of gypsum, are other examples. Crystals of quartz are sometimes curved and twisted. When this takes place in the left-handed and right-handed crystals, the twist is to the right or left, according as the crystal is right or left-handed.*

5



The surfaces of crystals are sometimes rounded in consequence of having been partially fused, or

* Figure 6, under quartz, is a *left-handed* crystal, as is apparent from the relative situation of the planes *o*, and *a*.

dissolved. The globular quartz of St. Lawrence Co., N. Y., is supposed by Prof. Emmons to have been thus rounded.

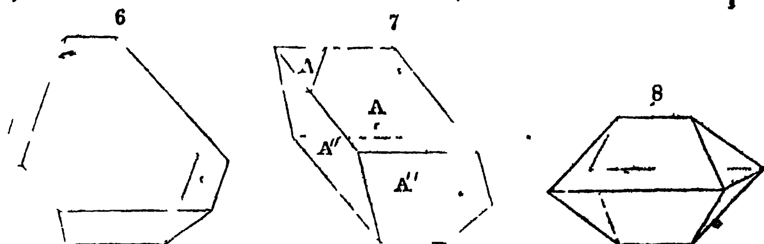
2. VARIATIONS IN THE FORMS AND DIMENSIONS OF CRYSTALS.

38. The simplest modification of form in crystals, consists in a simple variation in length or breadth, without a disparity in similar secondary planes. The distortion, however, extends very generally to the secondary planes, especially when the elongation of a crystal takes place in the direction of a diagonal, instead of the crystallographic axes. In many instances, one or more secondary planes are *obliterated* by the enlargement of others, proving a source of much perplexity to the young student. The interfacial angles remain constant, unaffected by any of these variations in form.

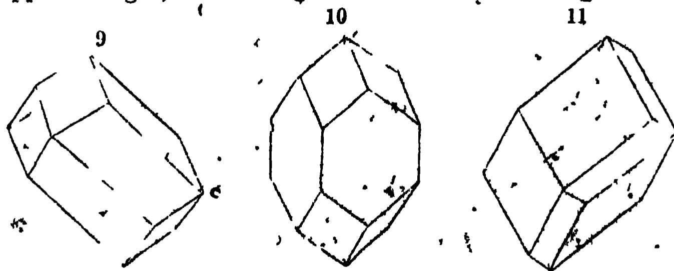
As most of the difficulties in the study of crystals arises from these distortions, this subject is one of great importance to the student.

39. *Monometric System.* A *cube* (figure 1, Plate I) lengthened or shortened along one axis, becomes a right square prism, (figure 50, Plate I:) and if varied in the direction of two axes is changed to a rectangular prism. (figure 69, Pl. II.) Cubes of pyrites, galena, fluor spar, &c., are generally thus distorted. It is very unusual to find a cubic crystal that is a true symmetrical cube.

An octahedron *flattened* parallel to a face is reduced to a tabular crystal, (fig. 6.) If *lengthened* in the same direction, it takes the form in figure 7; or if still further lengthened to the obliteration of A′, it becomes an acute rhombohedron, (same figure.)

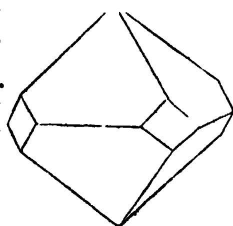


When an octahedron is extended in the direction of a line between two opposite edges, it has the general form of a rectangular octahe-

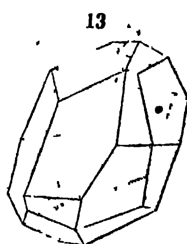


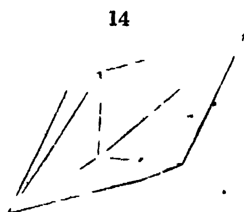
dron; and still farther extended as in figure 8, it is changed to a rhombic prism with dihedral summits. The figure represents this prism lying on its centre edge, (spinel, fluor, magnetic iron.)

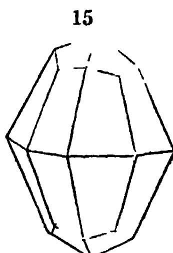
The *dodecahedron* lengthened along a line between the obtuse solid angles, becomes a six-sided prism with three-sided summits, as in figure 9; and shortened in the same direction, is a *short* prism of the same kind, (fig. 11.) Both resemble secondaries to the rhombohedron, and are common in garnet, and zinc blende. When lengthened in the direction of one of the crystallographic axes, it becomes a square prism with pyramidal summits, (fig. 10,) and shortened along the same axis it is reduced to a square octahedron with truncated basal angles, (figure 12.)

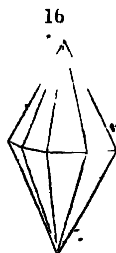

12.

The trapezohedron is still more disguised by its distortions. When elongated in the line of an octahedral axis it assumes the


13

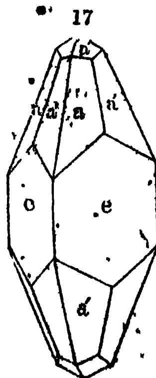

14


15

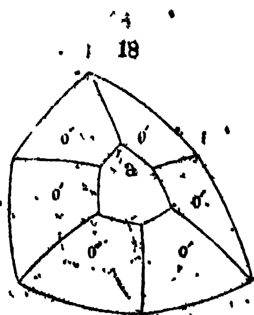

16

form in figure 13, and still farther lengthened, to the obliteration of some of the planes, becomes a scalene dodecahedron, (14.) This has been observed in fluor spar. If the elongation takes place along a crystallographic axis, it changes to a double eight-sided pyramid with four-sided summits, (fig. 15;) or if these summit planes be obliterated by a farther extension, it becomes a complete eight-sided double pyramid, (figure 16.)

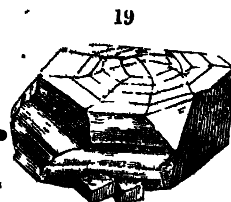
Still more complex forms are of occasional occurrence among



17



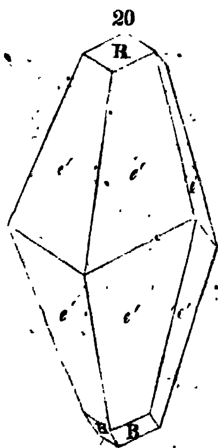
18

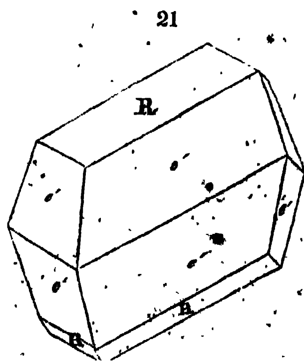

19

monometric crystals, especially when modified by secondary planes. Figure 17 represents a garnet from Monzoniberg; it is a combination of the dodecahedron and trapezohedron; but the crystal is so altered by distortion, that only *four* dodecahedral faces (e) remain, and *sixteen* of the trapezohedral, (a';) and the latter are of very unequal size.* Figure 18 is a distorted form of diamond. It is shortened in the direction of a diagonal, so that only two octahedral planes (a) remain, and 12 out of 48 planes o'—the six around each a, (see fig. 25, Plate I.) Figure 19 represents a crystal of Galena from Rossie. It is a shortened cube; the lateral faces are very irregularly curved and consist of the primary faces of the cube and the planes truncating the lateral edges. Some of the terminal edges are also truncated. The crystal is surmounted by a low pyramid, consisting of four planes on each of the angles and edges, which, owing to the distortion, do not occur elsewhere on the crystal. The cleavages of the crystal easily explain the relations of the several planes to the primary.

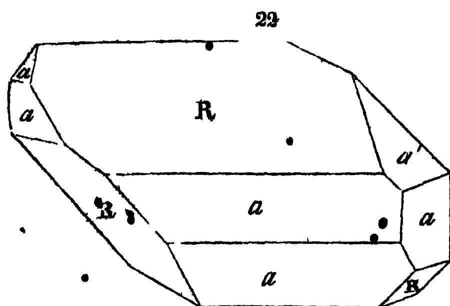
40. The following are a few instances in the other systems of crystallization. Figure 31, page 54, is a form of Zircon; only on part of the angles occur the planes o', owing to the extension of the other faces, (see figure 2, under *Zircon.*) It resembles a hemihedral crystal.

The annexed figure of calc spar, (fig. 20,) represents a scalene dodecahedron, with its apices replaced by planes of the primary rhombohedron.





A distorted form of the same is shown in figure 21, which appears, however, to be an eight-sided prism, bounded laterally by the planes R, e', e', and R, and their opposites, and terminated by the remaining planes of figure 20. The annexed figures of quartz, (fig. 22 and 23,) represent distorted forms of this mineral, in which some of the pyramidal faces, by enlargement, displace the prismatic faces, and nearly obliterate some of the other pyramidal faces.



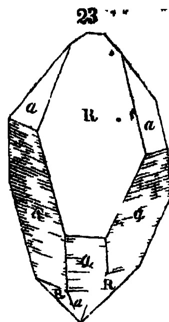
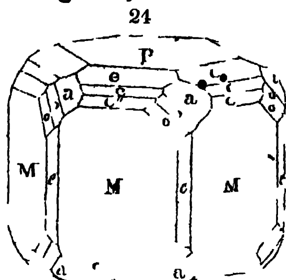
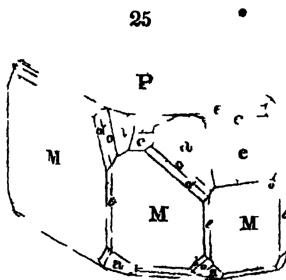


Figure 25 of apatite is the same form that is represented in figure 24, but greatly distorted. The planes e′, e, e″, between P and



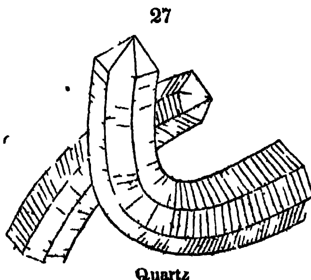


the left M, are enlarged, while the corresponding planes below are in part obliterated By observing that similar planes are lettered alike, the two figures may be compared throughout Figure 26 represents a hexagonal prism of beryl distorted so as to resemble a rhombic prism, with the acute lateral edges truncated, two opposite planes M, being nearly obliterated by the extension of the other four.

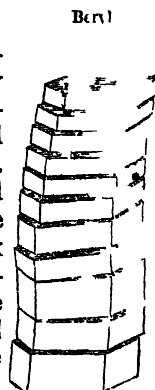
26
P
M M M
Beryl

Curved Crystals.

41. Curves in imbedded crystals are of frequent occurrence, and in implanted crystals they are not very uncommon. The annexed figure of quartz (fig. 27) illustrates this kind of distortion; the same is described by Beck as occurring in the apatite of St Lawrence Co., N. Y. Six-sided prisms of calc spar are occasionally curved in the same manner.



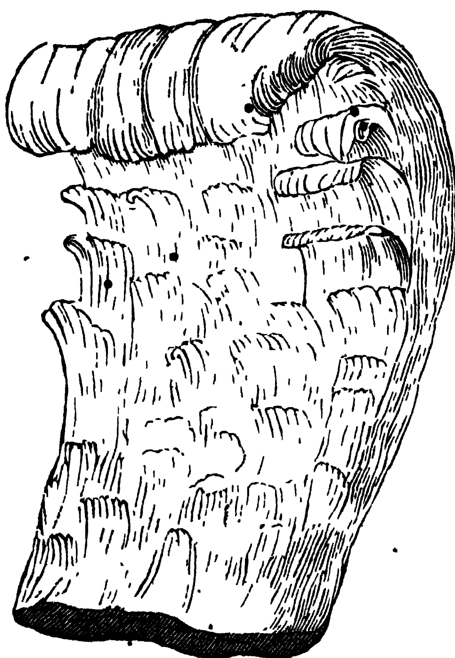
Quartz


Beryl Monroe Ct

In many species the crystals appear as if they had

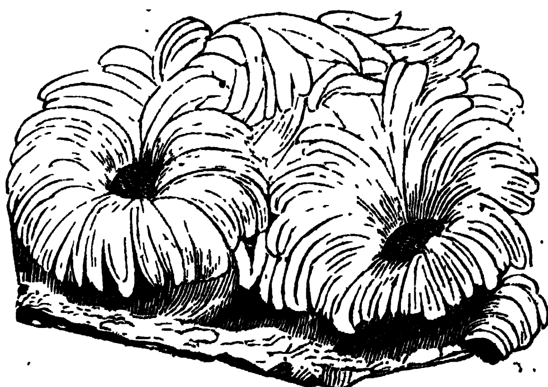
been broken transversely into many pieces, a slight displacement of which has given curved form to the prism. This is common in tourmaline and beryl. The beryl of Monroe, Conn., often present these interrupted curvatures, as represented in figure 28.

29



42. Very singular curvatures are described by Herschell, (Phil. Mag. 1833, II, 110,) as occurring in crystalline plates of ice adhering to stems of plants. These plates were implanted longitudinally on opposite sides of the stem, and curved so far around as nearly to encircle the stem. They were fibrous like some varieties of gypsum. The author observed similar crystallizations in March of 1836, in the vicinity of New Haven. The plates were attached to a single side of the stem, and curving around, almost enclosed it like a cylinder. Another instance of the same on a stone wall has been observed by Prof. Rigaud. The plates of ice were attached to the edges of the stones and curved away from the mortar. They were found only on a part of the wall recently built. Prof. Locke of Cincinnati, Ohio, has lately described (Sill. J. xlii, 206) similar crystallizations of alabaster (gypsum) from the mammoth cave of Kentucky. Alabaster "rosettes" occur there a foot in diameter, consisting of a disk surrounded by circles of leaves rolled elegantly outward; and tortuous vines with tendrils, and curled leaves, are

30



beautifully imitated. The drawings here given of these beautiful mineral flowers and vegetation, (figures 29 and 30,) were made from specimens in the collections of the National Institute.

Variations in the Angles of Crystals.

43. Variations in the angles arising from curvatures and imperfections of surface have been alluded to. Other variations are owing to impurities in the crystal. Calcareous spar is one of the most noted instances of this variation; it varies from 105° to 105° 17′. Pure crystals have the constant angle 105° 5′. These variations are in general so small as seldom to cause any difficulty in practice. Secondary planes, lustre, cleavage, and other peculiarities, will always distinguish a cube from a square prism, although the angles differ but 1″ from one another.

From the investigations of Mitscherlich it is ascertained that the angles of crystals vary with the temperature. In passing from 32° to 212° F., the angle of calc spar was diminished 8½′, thus approaching the form of a cube as the temperature increased. Dolomite, in the same range of temperature, diminished 4′ 6″. The angle of the prism of arragonite was increased 2′ 46″ while passing from 63° to 212° F.

Monometric solids dilate equally in all directions; but solids of unequal axes dilate differently in the directions of the different axes. In some rhombohedrons the vertical axis is lengthened, as in calc spar, while in others it is shortened, as in quartz. The variation is such either way, that the double refraction is diminished with the increase of heat, for calc spar possesses negative double refraction, and quartz, positive. According to Fresnel, the same is true of gypsum.

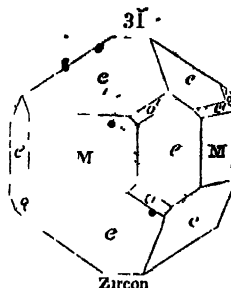
3. INTERNAL IMPERFECTIONS AND IMPURITIES.

44. The transparency of crystals is often destroyed by disturbed crystallization, or by impurities taken up from the solution during the process of crystallization. Oxyd of iron, chlorite, pyrites, silica, and alumina, are among the most common of these impurities. Any mineral indeed, that may be dissolved or mechanically suspended in the menstruum with the crystallizing mineral, may be thus entangled and forced into the constitution of forming crystals. Specimens of quartz are often permeated by oxyd of iron, chlorite, rutile, asbestus, gray antimony, iron pyrites, copper, silver, coal, &c.

The impurities often take a symmetrical arrangement. In general, foreign matter collects most abundantly about the centre and along the diagonal, and also in planes between the centre and edges of the crystal. The latter taking place in the cube, produces an arrangement similar in form to the cavernous cubes above described.

In chiastolite, the foreign matter is arranged about the central axis, and in planes running from this axis to the edges, and also about the lateral edges and exterior surface of the crystal. (see figures under chiastolite.) Dr. Jackson has observed the same in staurotide. Tremolite has also been observed, according to Nau-

mann, with an interior tesselated structure, like chiastolite. It had crystallized in contact with pulverulent carbonate of lime and magnesia. Fluor spar, common salt, and numerous other species, sometimes present similar appearances. The Zircons of St. Lawrence County, New York, often have a tesselated structure. Some crystals are grayish-white with the exception of the angles, which are bright chestnut-brown, either of a uniform color, or in parallel stripes about the plane o′. The annexed figure (figure 31) of a crystal in the possession of Prof. Emmons, represents the peculiar structure alluded to. The part within the dotted line has a deep reddish-brown color, while the rest is grayish-white; some of the planes o′ are wanting, in consequence of the extension of the other faces, and the unmodified angles are mostly white like the body of the crystal. In a similar crystal from the same region, Professor Beck found a nucleus of carbonate of lime, and it is probable, as he suggests, that the white coloring matter thus symmetrically arranged, is carbonate of lime.



31.
Zircon

In many instances, the foreign matter lies in layers parallel with some of the exterior planes. This is often noticed in crystals of quartz, in which there are layers of different colors parallel with the faces of the terminal pyramids. In this way transparent crystals sometimes have an exterior coating of an opaque white color. Tabular crystals of heavy spar are often banded parallel with the lateral faces.

The mica from Jones's creek, near Baltimore, as shown me by Mr. Markoe, of Washington, contains opaque lines or bands in concentric hexagonal figures, which are from the same cause. In one specimen the meeting of two hexagonal figures indicated a compound structure, or twin crystallization, a fact not apparent from any peculiarity on the surface of the mica. A mica from New Hampshire has similar markings; and in one transparent specimen in the cabinet of Dr. Jackson, of Boston, there are broad bands of a deep black color meeting at angles of 120° and 60°, the angles of the crystal.

4. PSEUDOMORPHOUS CRYSTALS.

41. *A pseudomorphous crystal is one which possesses a form that is foreign to it, and which it has received from some cause distinct from its own powers of crystallization.*

Pseudomorphous crystals may arise in different ways; either by the infiltration of foreign matter into the cavities of decomposed crystals; by the external accretion of foreign matter on the surfaces of crystals; or by a decomposition of a mineral, and its gradual replacement by another, possessing, often, no resemblance to the original mineral in its chemical constitution.

The first two methods are easily understood; in the first, the cavity acts the part of a mould, and gives all its peculiarity of form to the mineral that may infiltrate into it; in the second, a series of coatings are supposed to be formed around a crystal, and thus to produce a solid, presenting the form of the included crystal, though entirely different in chemical composition. The last of the three methods is by far the most frequent source of pseudomorphs, though the processes by which they have been formed is often very obscure. A number of changes of this kind have been described by Haidinger, in vols. ix and x of Brewster's Edinburgh Journal. *Specular iron*, the form of whose crystals is rhombohedral, has been observed in regular octahedrons, which is the primary of *magnetic iron ore*. The crystal, originally, belonged to the latter species; but a change of composition has taken place, without an accompanying change in the external form. Magnetic iron consists of one atom of protoxyd, and two of peroxyd of iron; specular iron, of pure peroxyd of iron; the only change required, therefore, is an additional oxydation of the protoxyd of iron, by which the whole becomes peroxyd or specular iron. In a similar manner, crystals of carbonate of lead, or *white lead*, are occasionally changed into *minium*, or oxyd of lead, without the least alteration in external form, the striæ of the surface remaining perfect. Similarly, minium may present the form of galena; Witherite, or carbonate of barytes, the form of sulphate of barytes or heavy spar; tungstate of iron or wolfram, the form of tungstate of lime, &c. In the last instance, there is merely a substitution of iron for lime, which would readily take place, provided iron were present, if any decomposing agent should remove the lime. Forms of this kind have been observed at Monroe, Conn. Other instances of more difficult explanation are, the pseudomorphs of Prehnite, imitative of analcime and Laumonite; of steatite, imitative of quartz, calcareous spar, spinel, hornblende, &c.; of quartz, imitative of fluor or calcareous spar. Haidinger supposes, with respect to the last, that "water, charged with carbonic acid, and by that means holding silica in solution, may have dissolved the original species, and deposited the silicеous matter in its stead." It has long been disputed whether the crystals of serpentine were pseudomorphous. This subject has lately been investigated by A. Quenstedt, (*Pogg*. No. 11, 1835,) who finds them identical in form with crystals of chrysolite, and shows that the change requires merely an addition of water, and a removal of a part of the magnesia, and may, therefore, be effected by the very common agents, aqueous vapor and carbonic acid.*

---

* Serpentine is represented by the following formula:—



$3\dot{M}g\,\underline{H}^2 + 2\dot{M}g^3\,\ddot{S}i^2$ and chrysolite by $\dot{M}g^3\ddot{S}i$.

If to four atoms of chrysolite $= \dot{M}g^{12}\ddot{S}i^4 = 2\dot{M}g^3\ddot{S}i^2 + \dot{M}g^6$, we add 6 atoms of water $= 6\underline{H}$, we obtain for serpentine, $2\dot{M}g^3\ddot{S}i^2 + 3\dot{M}g\underline{H}^2$, together with three atoms of magnesia, which are separated from the compound.

It may be doubted whether the first species of pseudomorphism pointed out above, ever takes place in nature. It is probable that the supposed instances of it, might more correctly be referred to the last method.

Pseudomorphous crystals are distinguished, generally, by their rounded angles, dull surfaces, and often granular composition. They either have no cleavage, or the cleavage is wholly different in direction from that of the mineral imitated. Their surfaces are frequently drusy, or covered with minute crystals. Occasionally the resemblance to real crystals is so perfect, that they are distinguished with difficulty.

CHAPTER IV.

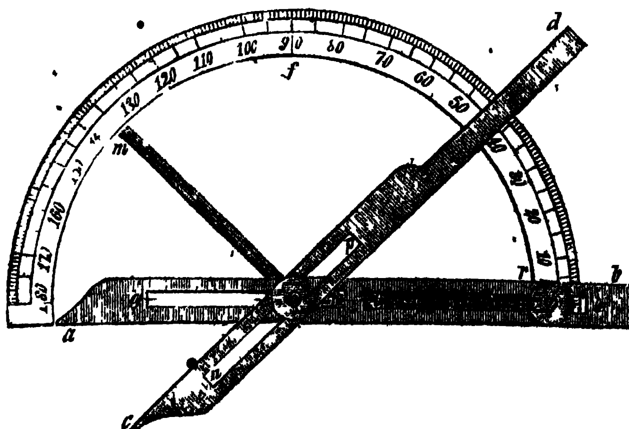
DETERMINATION OF PRIMARY FORMS.

46. The first question which arises in commencing the examination of a crystal is, what is its primary, or its system of crystallization? On account of the complexity or distortions of crystals, this question is sometimes answered with difficulty. The following methods will enable the student to overcome these difficulties.

1. Measurement of angles.
2. Inspection of the similarity or dissimilarity in the physical characters of different faces.
3. Cleavage.
4. The situation of secondary planes.

1. MEASUREMENT OF ANGLES.

47. The angles of crystals are measured by means of instruments called *Goniometers*.



The simplest of these instruments, called the Common Goniometer, is represented on the preceding page. It consists, 1. of a semicircular arc graduated to degrees, and, consequently, measuring 180°; 2, two arms, one of which, *ab*, is stationary, or admits only of a sliding motion backward and forward, by means of the slits *gh*, *ik*. The other arm turns on *o*, the centre of the arc, as an axis; there is also a slit, *np*, in this arm. By means of these slits, the parts of the arms below *o*, that is, *ao*, *co*, may be shortened, which is found necessary for the measurement of small crystals. The faces, whose inclination is to be measured, are applied between the arms *ao*, *co*, which are opened till they just admit the crystal, and are seen to be closely applied to the surfaces of the same. This should be determined by close examination, holding it at the same time up to the light and observing that no light passes between the arm and the plane of the crystal. The number of degrees on the arc, between *k* and the *left edge* of *d*, (this edge being in the line of the centre *o* of the arc,) is the required angle.

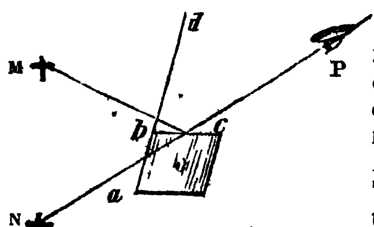
For measuring crystals partially imbedded, the arc is usually jointed at *f*, so, that the part, *af*, may be folded back on the other quadrant. When the angle has been measured, the arms are secured in their place by the screw at *a*, and the arc restored to its former position and there fastened by the bar, *mo*. The angle may now be read off.

The arms sometimes admit of being separated from the arc, in order to obtain more conveniently the required angle. They may then be adjusted to the arc in a very simple manner, which will be understood by the observer without explanation, and the angle read off as above.

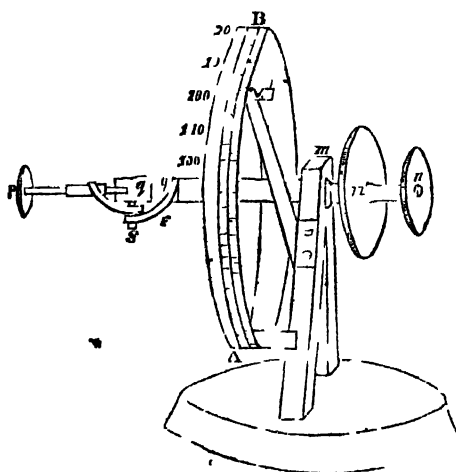
When a goniometer is not at hand, approximate results may be obtained by means of an extempore pair of arms, made carefully of Bristol board. After taking the angles with them in the manner explained, place them on a sheet of paper, and with a pencil and ruler lay off the angle by drawing lines parallel with, or in the direction of, each arm of the forceps. This angle may then be measured, by means of a graduated arc, or a scale of chords or tangents, either of which is usually to be found in a box of mathematical instruments, or may be obtained separately at the shops: or it may be measured by applying the arms directly to the graduated arc.

The results obtained with a common goniometer are seldom within a quarter of a degree of truth. It is, however, sufficiently accurate for common use. For polished crystals, we have a much superior instrument in the *Reflective Goniometer*, of Wollaston.

48. The reflective goniometer is represented on the next page. The principle on which this instrument is constructed may be understood by reference to the following figure, which represents a crystal, whose angle, *abc*, is required.



The eye at P, looking at the face of the crystal, *bc*, observes a reflected image of M. in the direction of PN. The crystal may now be so changed in its position, that the same image is seen reflected by the next face, and in the same direction, PN. To effect this, the crystal must be turned around, until *abd* has the present direction of *bc*. The angle *dbc*, measures, therefore, the number of degrees through which the crystal must be turned But *dbc*, subtracted from 180°, equals the required angle of the crystal *abc* The crystal is therefore, passed in its revolution through a number of degrees, which subtracted from 180 give the required angle This angle might be measured by attaching the crystal to a graduated circle, which shall turn with the crystal. This is effected by the ingenious and simple contrivance of Wollaston.



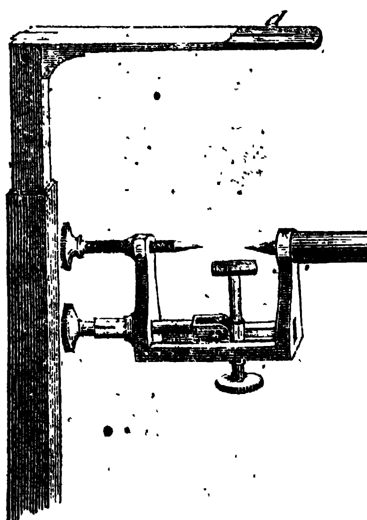
AB is the circle graduated to half degrees By means of the vernier, *v*, minutes are measured The wheel, *m*, is attached to the main axis, and moves the graduated circle, together with the adjusted crystal. The wheel, *n*, is connected with an axis which passes through the main axis, (which is hollow for the purpose,) and moves merely the parts to which the crystal is attached, in order to aid in its adjustment. The contrivances for the adjustment of the crystal, are at *p*, *q*, *r*. To use the instrument, it must be placed on a small stand or table, and so elevated, as to allow the observer to rest his elbows on the table. The whole, thus firmly arranged, is to be placed in front of a window, distant from the same, from six to twelve feet, with the axis of the instrument parallel to it. Before operation, a dark line should be drawn below the window near the floor, parallel to the bars of the window; or, what is still better, on a slate or board placed before the observer on the table.

The crystal is attached to the moveable plate, *q*, by a piece of wax, and so arranged, that the edge of intersection of the two planes, including the required angle, shall be in a line with the axis of the instrument This is done by varying its situation on the plate *q*, or the situation of the plate itself, or by means of the adjacent joints and wheel *r*, *s*, *p*

When apparently adjusted, the eye should be brought close to the crystal, nearly in contact with it, and on looking into a face, part of the window will be seen reflected, one bar of which must be selected for the experiment. If the crystal is correctly adjusted, the selected bar will appear horizontal, and on turning the wheel *n*, till this bar, reflected, is observed to approach the dark line below seen in a direct view, it will be found to be parallel to this dark line, and ultimately to coincide with it. If there is not a perfect coincidence, the adjustment must be altered until this coincidence is obtained. Continue then the revolution of the wheel, *n*, till the same bar is seen by reflection in the next face, and if here there is also a coincidence of the reflected bar with the dark line seen direct, the adjustment is complete; if not, alterations must be made, and the first face again tried. A few successive trials of the two faces, will enable the observer to obtain a perfect adjustment.

After adjustment, 180° on the arc should be brought opposite 0, on the vernier. The coincidence of the bar and dark line is then to be obtained, by turning the wheel *n*. As soon as obtained, the wheel, *m*, should be turned until the same coincidence is observed, by means of the next face of the crystal. If a line on the graduated circle now corresponds with 0 on the vernier, the angle is immediately determined by the number of degrees marked by this line. If no line corresponds with 0, we must observe which line on the vernier coincides with a line on the circle. If it is the 18th on the vernier, and the line on the circle next below 0 on the vernier marks 125°, the required angle is 125° 18′; if this line marks 125° 30′, the required angle is 125° 48′.

Some goniometers are furnished with a small polished reflector attached to the foot of the instrument, below the part *s q*, and placed at an oblique angle so as to reflect a bar of the window. This is an important improvement, as the reflected bar answers the purpose of the line drawn below the window, and is more conveniently used. This reflector may be easily added to the common instruments, placing it at an angle of about 45°, or such as will reflect the bar to the eye, when looking towards the crystal while observing.



The annexed figure represents an improved arrangement for adjusting the crystal, drawn from a German instrument. The contrivance *acd* is also an important addition. It contains a slit at *d* for sighting the crystals, by using

which, one of the lines may be dispensed with. It slides up and down in the part *ab*, and also moves back and forth, parallel with the plane of the graduated circle, on the pivot by which it is attached to the stand of the goniometer.

48. In goniometrical measurements, a knowledge of the following simple principle in mathematics is of great importance. "*The sum of the three angles of a triangle equals* 180°," or, in more general terms, "*The sum of the angles of a polygon equals twice as many right angles as there are sides less two.*" If there are five sides, the figure contains 2×(5–2)=6 right angles or 540°.

Having measured EAC, (see figure, p. 37,) when practicable, the angle FCA should also be measured. If the sum of the two angles thus obtained, equals 270°, (§ 23,) we may be quite confident of the correctness of the measurement; but if not, the measurement should be repeated.

If the angle EBF is oblique, the sum of the two angles, FCA and EAC, may be obtained, by adding to 180° the angle EBF; that is, if EBF=110°, 110°+180°=290°. If then, we find by the goniometer that the sum of the two angles equals 290°, the coincidence between observation and calculation is proof of accuracy. If there is not this coincidence, the measurements should be repeated. Errors may be thus corrected in the measurements of crystals.

By means of the goniometer we ascertain whether the angles of a prism are right or oblique; also, if oblique, their obliquity, and we are thus aided in deducing the form of the primary.

We also ascertain the inclinations of secondary planes, upon a knowledge of which depends in part our fourth method of arriving at the system of crystallization.

2. SIMILARITY, OR DISSIMILARITY OF THE DIFFERENT FACES.

49. This method is founded on the principle, that *like* crystalline faces *are invariably* similar in lustre and general appearance, and that *unlike* faces may be dissimilar in these respects.

The faces may differ in lustre, color, smoothness, or hardness.

If a right rectangular prism (as of iron pyrites) presents on examination, similar lines or striæ on the six faces, and also a similarity of lustre, we are led to infer, that the primary is a cube. If the similarity existed between the lateral surfaces only, we should conclude it to be a right square prism.

The difference of lustre of different faces is frequently but slight, and in smoothness they are often very closely similar. We are therefore compelled, in many instances, to employ other methods for determining the primary form. The dissimilarity in hardness may be of some importance; but in general, it is not sufficiently apparent to be used.

3. CLEAVAGE.

50. In using this method we observe the form cleavage affords, and the facility or difficulty with which it takes place in different

directions; also the lustre and appearance of the cleavage surface: remembering that similar faces are similar in cleavage and lustre, and the converse. The *cube* and *rhombohedron* are bounded by equal or similar surfaces, and cleavage is alike in the three directions; that is, the cleavages are equally easy, equally difficult, or equally unattainable, and afford surfaces of similar lustre. The lateral planes of the *square* and *rhombic* prisms are similar, and therefore the cleavages parallel with them, when any exist, are similar: moreover, the base of these prisms has a different cleavage from the lateral planes. In the *rectangular* and *rhomboidal* prisms, the three cleavages are dissimilar. Cleavage is often wanting parallel to one or more of these planes.

Close observation is seldom required for determining the similarity of two cleavages: for the difference, if any exists, is usually strongly marked. Anhydrite is a single exception to this remark. Its three rectangular cleavages are quite similar, though peculiarities may be observed in each of them.

This method of ascertaining the primary form, is often uncertain, owing to the existence of other cleavages in crystals besides those parallel to the faces of the primary. Some reference to this subject has already been made in § 11, where it is stated that a rhombic prism may have the cleavage of a rectangular prism, and vice versâ. In such cases, we must decide from analogy, either assuming those planes to be primary, parallel to which cleavage is obtained with the greatest facility, or, in some instances, those which are of the most frequent occurrence. The instances are very numerous in which this character entirely fails of affording any assistance, on account of the difficulty with which cleavage is obtained. Occasionally, we may be guided by the cleavage joints, which are sometimes apparent when cleavage is unattainable.

With the use of the three methods we have described, doubts will still exist in many cases, as to the primary form. The system of crystallization, which is in general all that we need know to understand a crystal, may however be ascertained with certainty. The following method is especially important in aiding us to determine the system of crystallization.

4. SITUATION OF SECONDARY PLANES.

51. The principles of this method have already been laid down in § 15; they depend on the law, that *similar parts of a crystal are similarly modified*. According to this law, the following table is constructed, in which the peculiarities of the situation of secondary planes in each class are so laid down, that the whole may be comprehended at a single glance.

The position of the right rhomboidal prism, assumed in the table, is that represented in fig. 88, Pl. I. The peculiarities of its secondary planes, with reference to its situation on its rhomboidal base, are described in a note.

SITUATION OF SECONDARY PLANES.

- 1. All the edges similarly modified.
  2. Angles truncated or replaced by three or six similar planes.
  - *Cube.*
  - *Regular Octahedron.*
  - *Rhombic Dodecahedron.*
  - **MONOMETRIC System.**

- 1. All the edges *not* similarly modified.
  2. *Two** or *none* of the angles truncated or replaced by three or six similar planes.
  - The number of similar planes at each extremity of the crystal, either three or some multiple of three.
    - *Rhombohedron.*
    - *Hexagonal Prism.*
    - **HEXAGONAL System.**
  - The number of similar planes at each extremity of the crystal, neither 3, nor a multiple of 3.
    - The *superior* basal modifications in front *not* similar to the corresponding *inferior* in front or *superior* behind.
      - Two *adjacent*, or two *approximate* similar planes impossible.
        - *Oblique Rhomboidal Prism.*
        - **TRICLINATE System.**
      - Two *adjacent*, or two *approximate* similar planes possible.
        - *Oblique Rhombic Prism.*
        - *Right Rhomboidal Prism.*
        - **MONOCLINATE System.**
      - N. B. The Right Rhomboidal Prism on its Rhomboidal base may be distinguished from the other right prisms by the dissimilar modifications of its lateral and basal edges and angles.
    - The *superior* basal modifications in front similar to the corresponding *inferior* in front, or *superior* behind.
      - 1. The similar secondary planes at each base either 4 or 8 in number.
        2. All the lateral edges (if modified) simil. truncated or beveled.†
        - *Right Square Prism.*
        - *Square Octahedron.*
        - **DIMETRIC System.**
      - 1. The similar secondary planes at each base, either 2 or 4 in number.
        2. All the lateral edges, (if modified.) *not* similarly truncated or beveled.†
        - *Right Rectangular Prism.*
        - *Right Rhombic Prism.*
        - *Rhombic Octahedron.*
        - **TRIMETRIC System.**

* The rhombohedron is the only solid included in this division, any of whose angles admit of a truncation or replacement by three or six planes.

† The terminal edges of the octahedrons are here termed lateral, in order that these statements may be generally applicable both to prisms and octahedrons.

The following are important laws for determining dissimilarity of planes; and their application will often prove a similarity where, from the great dissimilarity in the size of the planes, it was not supposed to exist.

1. Planes equally inclined to the same plane, are similar.

2. Planes equally inclined to similar planes, are similar.

52. The following are a few examples of the mode of applying this table. We may select, first, figure 1, of the species *iron pyrites*. Its primary form is required.

We inquire, *first*, are all the edges similarly modified? We observe that they are; and, therefore, the crystal belongs to the monometric system. The particular primary may be determined by either of the three preceding methods.

The perfect symmetry in the forms of this class, is so remarkable, that a cursory glance will distinguish them immediately from any of the other classes, without a particular examination of the above fact.

With reference to figure 8 of calcareous spar, (see the descriptive part of this treatise,) we ask the same question, but find that all the edges are not similarly modified, and the angles are not truncated or beveled. The general appearance of the crystal alone would distinguish it from the monometric forms. We proceed and inquire, *second*, Is the number of similar planes, at each extremity of the crystal, in any instance, either three or a multiple of three? We observe, in the figure, one R at the upper end, and two, at the lower. These latter must have their opposites above, and, therefore, there are three R's at the upper extremity. This is sufficient to decide the question in the affirmative. But, looking farther, we also find that there are three planes e; two are visible at the upper extremity, and the third is seen below. In these examinations, it may be taken as an invariable rule, that the number of faces of any one kind, represented at *both* extremities of a *figure* of a crystal, (exhibiting only a front view,) indicates the number actually existing at *each* extremity, and for the reason that each face has one similar to it, diagonally opposite. Hemihedrism produces some exceptions, but they will cause no difficulty in the application of the above principle.

To continue, we observe, on this principle, six planes e′, at each extremity, six planes *e*′, three planes *a*″ and *a*′; so that, in every instance, the number of planes of the same kind is either three, or a multiple of three. The same will prove to be the fact with the figures of apatite, quartz, &c.

We therefore conclude, that this crystal has either a rhombohedron or a hexagonal prism, as its primary; that is, it belongs to the hexagonal system. We may infer, that the rhombohedron is the primary, from the occurrence of only three planes of some kinds; the hexagonal prism is always modified with at least six

planes of each kind, at each extremity. See figures of crystals of beryl, &c.

For farther elucidation, we may consider figures of the species pyroxene and anorthite. In answer to the first and second queries, these figures give a negative reply. There are not three planes of any one kind at either extremity of these crystals. We, hence, make the *third* inquiry, Are the front superior basal edges and angles modified in the same manner as those below, or the posterior above? This is not true with either figure. In figure 3, of pyroxene, the plane ǎ has no corresponding one above; so, also, there are two planes on an inferior basal edge of anorthite, and but one on the corresponding superior. Other planes concur in deciding the question in the negative: but a single instance is sufficient.

The figures, therefore, belong to oblique prisms, and may be of the monoclinate or triclinate system.

We then make the subordinate inquiry, Are there two adjacent or approximate similar planes in these crystals. In the figure of pyroxene we observe two similar M's. If we doubted their similarity, we might decide it by finding with the goniometer, that ĕ inclines equally on these planes. We hence conclude, that the crystal belongs to the monoclinate system. We might also observe the pairs of faces ō, ō, *a*, *a*, &c., and thus dispense with any measurement.

In the figure of *anorthite* we find no adjacent or approximate similar planes; no plane on the edge P : T, corresponding with that on the edge P : M. The planes *'a*, *a'*, which appear to be similar, are unlike in their inclinations, and, therefore, dissimilar. Looking the whole figure through, we find no two similar planes. We hence infer, that this crystal is *triclinate*.

Again. With a view of examining fig. 2, of the species *heavy spar*, we make the same, *first*, *second*, and *third* inquiries, and find that the reply to each is in the negative. We observe, that the similar planes are not in any instance a multiple of three, that there are similar planes, a a, *a a*; e e, at each extremity in front. We, therefore, continue the investigation, by making the fourth inquiry, Are there in each instance four or eight similar secondary planes at the extremities of the crystals, or are there but two, and not more than four, of some planes? We observe but two planes *a*. The crystal, therefore, belongs to the trimetric system. If we look farther, we find only two planes, a, and four planes, ŏ. If these four planes were the only secondaries at each extremity, it would be necessary to look to the planes on the edges, and ask, *fifthly*, Are all the lateral edges similarly truncated or beveled? But evidently the plane ĕ differs from plane ē. This decides again the figure to represent a trimetric solid. With reference to fig. 3, of idocrase, we observe the lateral edges similarly truncated and beveled; we also find eight planes, o', o'', o''', &c. The conclusion is, therefore,

that the figure belongs to a dimetric crystal, and has a right square prism, or a square octahedron for its primary.

The reader is advised to select from the figures in the descriptive part of this treatise, and attempt to apply the above principles, in order to become fully acquainted with them. In their application, if the crystal has a prismatic form, we may consider any of the faces of the prism as lateral planes, (with this restriction, that if one of two similar planes be selected, the other must also be,) for the above interrogations will apply equally well, whatever selection be made, and the conclusions will be equally correct. Thus, in the figure of heavy spar, we may assume $\bar{e}$ and $\bar{e}$, or $\bar{e}'$ and $\bar{e}'$, for primary planes, and still the conclusion will be obtained, that the crystal is trimetric.

CHAPTER IV.

COMPOUND CRYSTALLINE STRUCTURE.

53. The compound crystalline structure of minerals may arise from the nature of the power of crystallization, independently of the influence of external causes; or it may result from the influence of external causes, acting in conjunction with the power of crystallization. In the first case, the mineral still presents externally, crystalline faces, and the individuals consist of two or more crystals intimately united in their internal structure. They are called *Compound* or *Twin Crystals*.

The second kind of compound structure is exemplified in specimens which are said to be imperfectly crystalline, and which are aggregations of numerous imperfect crystals, either laterally apposed, as in the fibrous structure, or confusedly mingled, as in minerals of a granular structure.

1. COMPOUND CRYSTALS.

54. Compound crystals are analogues of monsters in the animal kingdom. They may be composed of two united crystals, or of several.

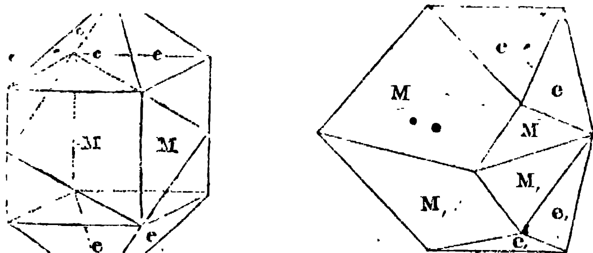
Compound Crystals, composed of two individuals, or Twin Crystals.

Representations of some of these compound forms are given in figs. 13, 14, 15, 16, Pl. III. Their structure may be imitated by cutting a model of a crystal in two halves, inverting one of the halves, (or revolving it 180°,) and then applying it thus inverted to the other half, bringing the same surfaces in contact that were separated. Fig. 128, Plate II, is an octahedron, which is represented as

cut in two in the plane, *a*, *b*, *c*, *d*. If we revolve one half 60° or 180°, and reapply it to the other, it produces the form in fig. 129.

If a rhombic prism be divided in a vertical plane, parallel to a lateral face, (fig. 130,) and one of the parts be revolved half around, as it were on an axis passing from M to the opposite face, the form in figure 131, is obtained. This is easily verified by actual trial.

If the same rhombic prism were divided in the diagonal section, and a similar revolution of one half were made, no twin crystal would result. But with an *oblique* rhombic, in which the base is inclined to the lateral planes, a solid similar to that in fig. 14, Pl. III, is obtained.



The first of the above figures is a right square prism, terminated by four-sided pyramids. This solid we may bisect in a diagonal plane, passing from one solid angle to the opposite. One half inverted and applied to the other produces fig. 2.

We have thus described all the kinds of twin crystals composed of two individuals, that occur in nature.

In the *first*, composition takes place parallel to a primary face; in the *second*, parallel to a plane on an edge; in the *third*, parallel to a plane on an angle.

The plane *on an edge* is the truncating plane of the same, or that which corresponds to it in the inequilateral primaries; that is, it has the simple ratio 1 A : 1 B, (§ 22.) Also, the plane on an angle is the truncating plane of the same, or that which has the simple ratio 1 A : 1 B : 1 C.

The twin crystals produced by the above methods, will hereafter be described as twin crystal of the *first*, *second*, and *third* kinds.

These crystals may be modified by secondary planes in the same manner as simple crystals.

Figure 16, Plate III, represents a scalene dodecahedron of calc spar; in which composition has apparently taken place, parallel to a horizontal section through its centre. By considering the situation of the primary rhombohedron in this solid, it is perceived that the composition is parallel to a plane truncating the terminal solid angle, and is, consequently, of the *third* kind. This figure presents

none of the faces of the rhombohedron, which indicates the perfect union that exists between the two individuals, or rather, that their union was cotemporaneous with the commencement of their formation, and proceeds from the double nature of the first stone that was laid in the construction of the crystal. These forms are, in this respect, distinct from a kind of compound crystal, arising from the union of two crystals some time subsequent to the commencement of their formation. The former are designated *connatal* compound crystal, the latter *postnatal;* the commencement of the former being cotemporaneous with that of the crystals composing them, while in the latter, it is subsequent to the same.

Composition parallel to some plane on an edge or angle different from the one above stated, occasionally takes place in crystals that are hemihedrally modified.

In the species *iron pyrites* twins are of frequent occurrence compounded parallel to a face of a pentagonal dodecahedron. Observing that the edges of the cubes of this mineral are never *truncated*, but when modified, are replaced by the planes of this hemihedral solid, it is obvious that this peculiarity is owing to the same modification of the molecule that causes its hemihedral crystallizations.

A geniculated crystal of quartz has been described by Brooke, (Phil. Mag. May, 1837,) in which composition took place parallel to a plane truncating a pyramidal edge. This plane referred to a rhombohedral primary, is an intermediary. But crystals of quartz are so uniformly modified hexagonal prisms, that we infer with reason that the hexagonal prism is in effect its primary; and referring the plane to this primary, the composition is of the *third kind* or parallel to a plane on an angle.

Compound Crystals, composed of more than two individuals.

55. The same kind of composition often takes place parallel to more than one primary face, edge, or angle, producing compound crystals composed of several individuals. Fig. 3, Pl. IV, is a hexagonally prismatic crystal of white lead, in which composition has taken place parallel to two primary faces. This crystal resembles a secondary to a rhombohedron or hexagonal prism, but is distinguished by the inequality of its lateral angles. Figure 5, Plate IV, is a stellated form of carbonate of lead, in which the composition is parallel to all the lateral faces.

Occasionally the same compound crystal exhibits *two* of the *three kinds* of composition. Forms of this kind have been observed in sphene and calc spar.

This subject will be continued more at length in a future section on the internal structure of crystals.

Compound crystals may usually be distinguished by their re-entering angles, or by the striæ on their surfaces. These striæ meet

at an angle in the line where composition has taken place. (See figures of Chrysoberyl.)

It is very possible that twins of the first kind may occur in rectangular prisms, which are not distinguishable on account of the rectangularity of the crystals. An attempt to form a twin crystal of the *first* kind out of a rectangular prism, that would exhibit its compound structure, would be ineffectual; for it requires obliquity in some of the interfacial angles. Some undoubted instances of a compound nature, in crystals, of this kind, have been detected by Sir David Brewster, by the assistance of polarized light.

56. The positions of crystals in the supporting rock seem at first to be without any regularity. By closer inspection we detect even here the same laws of harmony, that govern the formation of the simple and compound crystal. The various posi ions assumed are three in number, and correspond with the three kinds of composition in twin crystals. Brooke observes with respect to certain artificial crystallizations of nitrate of lead, that some of the octahedrons "had their axes perpendicular to the surfaces on which they rested"—"others rested on one of their planes, and others were attached by an edge to the bottom of the vessel;" thus exemplifying each of the three kinds of composition. This regularity is not always manifest on account of the unevenness of the surface on which they rest. In general, however, on glancing the eye over a surface covered with crystals, a reflection from one face will be accompanied with reflections from the corresponding face in each of the other crystals, showing that the faces lie in one plane, or that the crystals are similar throughout in their positions.

This tendency to parallelism in the position of associated crystals is even apparent in crystalline aggregates. In granite, for example, which is composed of feldspar, quartz, and mica, the feldspar crystallizations have usually a common position; that is, the corresponding extremities lie in the same direction, or nearly. On this account granite is cleavable in one direction more easily than in others, and this direction is that of the perfect cleavage plane of the feldspar. The parallel positions of the mica in gneiss causes the fissile character of this rock.

Postnatal Compound Crystals.

57. We have already defined postnatal twins to be those in which composition has taken place after each crystal had attained some considerable size. Figure 11, of quartz, represents one of these double crystals. The simple crystals in these instances are uniformly united by similar parts, and, consequently, have their similar faces parallel.

Groups of crystals, consisting of aggregations of crystals of various sizes, are frequently instances of postnatal composition. Often, however, the aggregation is very irregular.

The doubly geniculated crystals are instances of a second kind of postnatal compound crystal. One of these forms is represented in figure 12, Plate IV. These geniculations were evidently formed after the crystal had attained some size, and not at the commencement of its formation. (For a more particular account of the structure of these forms, see the remarks on Crystallogeny, § 73—78.)

2. AGGREGATIONS OF IMPERFECT CRYSTALS.

58. The greater part of the specimens of minerals that occur on our globe, may be described as aggregations of imperfect crystals. Even those whose structure appears the most purely impalpable, and the most destitute internally of any thing like crystallization, are probably composed of crystalline grains. An examination of Chalcedony by means of polarized light, by Sir David Brewster, has proved this to be true with respect to this mineral, and few species occur which appear to the eye more perfect specimens of a complete absence of crystallization. Indeed, what is still more remarkable, according to Sir David Brewster, "the phenomena of polarization have proved that the jellies of oranges and gooseberries are really crystallized, and that they even possess double refraction."* We, consequently, include under the above head, all the remaining varieties of structure in the mineral kingdom. The only certain exceptions are liquids and gases, which require so few remarks, that a separate caption for them is unnecessary.

The individuals composing imperfectly crystallized individuals, may be,

1. *Columns*, or *fibres*, in which case the structure is *columnar.*
2. *Thin laminæ*, producing *lamellar* structure.
3. *Grains*, constituting the *granular* structure.

1. *Columnar Structure.*

59. A mineral possesses the columnar structure, when it is composed of elongated columns. These columns vary much in their relative situation, and produce several varieties of the columnar structure.

Fibrous: when the columns or fibres are parallel. Ex. gypsum, asbestus.

Reticulated: when the fibres, or columns, cross in various directions, and produce an appearance having some resemblance to a net.

Stellated, or *stellular:* when they radiate from a centre in all directions, and produce star-like forms. Ex. stilbite, gypsum.

Radiated, divergent: when the crystals radiate from a centre, but not, necessarily, producing stellar forms. Ex. quartz, gray antimony.

* Brewster's Ed. Jour. Vol. X. p. 28.

Globular, reniform: when, by radiating from a centre in every direction, a spherical, hemispherical, or kidney-shaped individual, is produced. When attached, as they usually are, to the surface of a rock, these are described as *implanted globules.* If the surface of the globular masses is rough with minute terminations of small crystals, it is described as *drusy.* This term is also applied to surfaces covered with minute crystals.

Botryoidal: when there is a tendency to radiation from a centre, and the surface formed is covered with rounded prominences. The name is derived from the Greek, βότρυς, *a bunch of grapes.* Ex. Brown iron ore, Chalcedony.

Mammillary: resembles the botryoidal, but is composed of larger prominences.

The fibres are described as *filiform* or *capillary,* when very slender and much elongated.

Stalactitic: when the mineral occurs in pendant columns, cylinders, or elongated cones.

Stalactites are produced by the percolation of water, holding mineral matter in solution, through the rocky roofs of caverns. The evaporation of the water produces a deposit of the mineral matter, and gradually forms a long pendant cylinder or cone. The internal structure may be perfectly crystalline, or may consist of fibres radiating from the central column.

Common stalactites consist of carbonate of lime. Chalcedony, Gibbsite, brown iron ore, and many other species, also present stalactitic forms.

2. *Lamellar Structure.*

60. The structure of a mineral is lamellar, when composed of plates or leaves. The laminæ may be curved or straight, and thus give rise to the *curved* lamellar, and *straight* lamellar structure. Ex. tabular spar, some varieties of gypsum, talc, &c.

3. *Granular Structure.*

61. The granular particles of composition differ much in their size. When very coarse, the mineral is described as *coarsely granular;* when fine, *finely granular;* and if not distinguishable by the naked eye, the structure is termed *impalpable.* Examples of the first may be observed in granular carbonate of lime, colophonite, the coccolite variety of pyroxene; of the *second,* in some varieties of specular iron; of the last, in Chalcedony, opal, and most of the mineral species.

The above terms are indefinite, but from necessity, as there is every degree of fineness of structure in the mineral species, from the perfectly impalpable, through all possible shades, to the coarsest granular.

Globular and reniform shapes are occasionally presented by minerals of a lamellar or granular structure.

SECTION II.

CRYSTALLOGENY.

62. Crystallogeny, or the formation of crystals, may be treated of under two heads:—

1. The *theoretical* part, containing the various theories which have been adduced to account for the structure of crystals, and a particular illustration of that which appears to be most consistent with facts.

2. The *practical* part, including the different processes of crystallization and the attendant circumstances.

CHAPTER I.

THEORETICAL CRYSTALLOGENY.

THEORIES OF VARIOUS AUTHORS.

63. What are the laws by which molecules are superimposed on molecules in perfect order, and these tiny yet wonderful specimens of architecture constructed? What is this crystallogenic attraction? What the nature of the ultimate particles of matter?

Speculations on these subjects have displayed the ingenuity of men of science in various ages of the world. The Grecian philosophers, to account for the various phenomena in nature, imagined these ultimate particles or atoms to be, at different times, "round, oval, lenticular, flat, gibbous, oblong, conical, smooth, rough, quadrilateral,"* and, to afford these atoms the means of uniting in the production of compounds, provided them with hooks. The investigations of modern times have not, indeed, answered the query, what is this plastic power in nature; but philosophers have been led to satisfy themselves with calling it by the general term, *attraction*, a term rather expressing the fact, that particles combine, than explaining the nature of this power.

* Epicurus.

This subject lay uninvestigated, and almost forgotten, from the times of the ancient philosophers till the 13th century.* From the 13th to the 17th century, appeared Albertus Magnus,† Agricola,‡ Cæsalpinus,§ Boetius de Boot,‖ Baptista von Helmont,¶ Christian Huygens,** Boyle,†† and many others, who advanced various hypotheses as to the *seeds* of crystals, their *generation*, &c. But, excepting Huygens, who, in a very recondite treatise first developed the doubly-refracting nature of Iceland spar, and inferred that its elementary particles were spheroids to account for this peculiar refraction, none made any real improvements on the speculations of their predecessors.

With Nicolaus Steno, towards the latter part of the 17th century, commences a new era. This author examined minutely, the different forms of several minerals and accurately described them. He also first deduced the important principle in Crystallography, afterwards rediscovered, that, *although the faces of crystals are subject to frequent variations of form, their inclinations remain constant.*‡‡ In the commencement of the 18th century, Gulielmini published on the crystallizations of the salts, and advanced another principle equally fundamental, that *cleavage in crystals of the same substance yields constantly the same forms.* Gulielmini was led, by his observations, to the same conclusions as the Abbé Haüy, namely, that the elementary corpuscles of bodies possessed those simple forms which may be obtained from crystals by cleavage.§§ He neglected, however, to extend his investigations on this

* Many of the following facts have been cited from a valuable work on the history of Crystallography, by Dr. C. M. Marx, entitled, *Geschichte der Crystallkunde*, 314 pp. 8vo. Carlsruhe und Baden, 1825.

† De Mineralibus et Rebus Metallicis; 12mo. Colon. 1619.

‡ De Ortu et Causis subterraneorum. Basiliæ, fol. 1657.

§ De Metallicis Libri Tres; Noribergæ, 1602. In Book II, 19, he says: "Relinquitur igitur ut sola hexagona fiat, sola enim perfecta est, quia fit ex triplici divisione superficiei ad angulos acutos, sex triangulis in unum veluti centrum coeuntibus, ut omnes anguli externi majores sint recto, ideo ad circuli naturam prope accedunt."

‖ Gemmarum et Lapidum Historia, quam olim edidit Anselmus Boetius de Boot, postea Andr. Tollius. Lugd. Bat. 1647.

¶ In a work published in German at Sulzbach, in 1683, he subscribes to the opinion, that the different crystals, like plants and animals, proceed each from its own peculiar seeds.

** *Christ. Huygenii*, Op. Vol. I. Amst. 1728, 4to. Tractatus de lumine.

†† *R. Boyle*, Specimen de Gemmarum Origine et Virtutibus. Colon. Allobr. 1680. 4to. P. 6, we find, "Reperiebam in solida lapidis massa cavitates, quarum latera undique circumdederant concretiones, quæ cum essent pellucidæ instar crystalli et elegantissime figuratæ, (calcareous spar?) videbantur fuisse *succus lapidescens* purior, qui tandem percolatione quadam per substantiam crassioris lapidis penetraverat in illas cavitates, et postquam evaporassent superfluæ et aqueæ partes, aut imbibitæ fuissent a vicino lapide, poterant concurrere in pura illa crystalla."

‡‡ *Nic. Stenonis*, Dissertationis Prodromus de Solido intra Solidum naturaliter contento. Pistorii, 1763—(first published at Florence, 1669, also, in the Collect. Academ. de Dijon, Partie etrang. T. IV, p. 383.)

§§ De Salibus Dissertatio epistolaris physico-medico-mechanica conscripta a *Dominico Gulielmini*; Lugd. Bat. 1707, 8vo. p. 2. "Determinatam figuram non ab universali aut particulari architectonico spiritu, non a propria innominata forma, sed a primarum particu-

subject, and left to Romé de Lisle and Haüy the honor of founding the *science* of Crystallography.

Several writers on these subjects appeared during the half century following Gulielmini; but they made no essential additions to facts.—The theory of tetrahedral atoms was proposed by Ludwig Bourguet.*

J. Woodward, an English author, makes quartz crystal the source of all crystallizations, concerning which, he thus expresses himself in his treatise on his collection of "English Fossils,"† p. 146: "There is in all spar more or less crystal, which renders it more or less diaphanous," &c. Again, p. 220: "Crystal, pure and without mixture of other matter, concretes even into an hexagonal figure, pyramidal or columnar, terminating in an apex or point. Mineral or metallic matter concreting with it, frequently determines it to other figures peculiar to the disposition of each kind of that matter. *Iron* concreting with crystal, determines it to a rhomboid figure; *tin*, to a quadrilateral pyramid; *lead*, to a cubic."

Somewhat similar was the opinion of Linnæus, who supposed that all crystals contained a salt, and to this owed their crystallization.‡ This theory obtained considerable credit at that time. We find it clearly expressed in the Philosophical Transactions for 1749, p. 250, by W. Borlase: "'Tis by the force of *salts* that liquid bodies are thrown into all the geometrical planes, angles, and more compounded shapes, the variety of which is no less surprising, than the constancy and uniformity of each particular species." The discoveries in chemistry soon dissipated these views, and at last established philosophers on this settled ground, that the power of crystallization is naturally and independently inherent in all inorganic matter.

Immediately preceding the commencement of the Abbé Haüy's very successful scientific career, appeared Bergman, Werner, and Romé de Lisle. Bergman has the honor of discovering the primary forms of crystals, and Romé de Lisle that of first measuring their angles, and thus rendering crystallography subservient to the purposes of the mineralogist.

64. Haüy seems to have entered on his studies with an entire ignorance of the investigations of Bergman and Gulielmini, and in all his observations was an original investigator. A mere accident,

larum schemate unice esse derivandam." P. 10; "corpuscula insectilia, terminata planis superficiebus ita ad invicem inclinatis, ut simplicem aliquam includent figuram." P. 19; "figuris non omnibus, quæ possibiles sunt, utitur natura, sed certis quibusdam tantum, quarum determinatio non est a cerebro eximenda, aut a priori probanda, sed ab experimentis et observationibus desumenda."

* *L. Bourguet*, Lettres philosophiques sur la formation de sels et de cristaux; Amsterd. 1729, 8vo.

† An attempt towards a natural history of the fossils of England, in a Catalogue of the English Fossils in the collection of *J. Woodward;* 2 vols. Lond. 1728–9.

‡ Systema Naturæ. ed. VI. p. 160; "Crystallus lapidea sal non est, sed continet sal, cujus figuram gerit, omnis enim crystallizatio ex salo," &c.

the dropping of a crystal from his hands, and its fracture in consequence, exhibited to him the rhombohedral particles of carbonate of lime. He was thus led to commence his investigations, and with his philosophic mind soon arrived at general conclusions with regard to the primary forms.—An obvious theory as to their structure, *that* already proposed by Gulielmini, though unknown to Haüy, was the next result of his investigations. The primary cube he imagined to be constituted of cubic molecules, for cubes and cubes only, can be obtained by mechanical division. Similarly, the rhombohedron was formed of rhombohedral molecules.

Investigations, with respect to the situation of secondary planes, and the laws which govern their formation, gave the Abbé what appeared to be additional proof of the correctness of his theory. He discovers that secondary planes on the edges of crystals, may be formed by composing a primary of its molecules, and dropping one row, (of, in his phraseology, by a decrement of one row,) of particles, in height and breadth, (fig. 132, Pl. II,) or, two rows in one direction, and one in the other, (fig. 133,) or, three rows in the first and one in the second, or, in some other simple ratio: also, that planes on the angles may be formed either by dropping a single row in each of the three directions about an angle, which he calls (as also in the first case above) his *simple decrement*, and may be expressed by the ratio 1 : 1 : 1; or by the ratio 1 : 1 : 2, that is, two in height, and one in each of the other directions; or the ratio 1 : 1 : 3, or 2 : 2 : 1. These, and a few other simple ratios, would form all actually occurring planes on angles. These splendid results proved, that the science of Crystallography was founded on a sure mathematical basis, at the same time, that they apparently afforded very convincing evidence of the truth of Haüy's views with regard to the structure of crystals, and the nature of their molecules.

It appeared, however, to be a difficulty, that cleavage was obtained in some instances, parallel to two primaries at the same time. The rhombic prism, besides its rhombic cleavage, admitted of cleavage parallel to its diagonal, thus dividing it into two three-sided prisms. Again, the octahedrons could not be composed of octahedral molecules, except by leaving large spaces, to fill which, tetrahedrons were necessary. The Abbé Haüy surmounted the first difficulty, by supposing the molecules to be composed of still simpler solids, which he called integrant molecules. These are the tetrahedron, the three-sided prism, and the parallelopiped.

The second difficulty however remained, and could only be avoided by the improbable hypothesis of two nucleal solids, an octahedron and a tetrahedron.

The difficulties lay unremoved, when Dr. Wollaston brought forward his very ingenious views on the *spherical* forms of the molecules of bodies, in the Philosophical Transactions for 1813. It is easily conceived, that many of the primary solids in Crystallography may be formed by the regular aggregation of spheres. Two

four-sided pyramids of shot, (similar to those frequently seen in arsenals,) placed base to base, form the regular octahedron, (fig. 134.) If, to the octahedron, two three-sided pyramids are added, (tetrahedrons, fig. 136,) one to each of two opposite faces, a rhombohedron is formed, (fig. 135.) A rhombohedron of this kind is easily obtained in the cleavage of fluor spar; it is reduced to the octahedron by separating two tetrahedrons.

Rhombohedrons, however, occur of various angles. To obtain these, it is only necessary to suppose the particles of other rhombohedrons to be spheroids, instead of spheres; spheroids are also his molecules of the prisms. The formation of the cube is illustrated by Dr. Wollaston, as follows: "Let a mass of matter be supposed to consist of spherical particles, all of the same size, but of two different kinds in equal numbers, represented by black and white balls; and let it be required that, in their perfect intermixture, every black ball shall be equally distant from all surrounding white balls, and that all adjacent balls of the same denomination shall also be equidistant from each other. I say, then, that these conditions will be fulfilled, if the arrangement be cubical, and that the particles will be in equilibrio." He had previously stated that "a cube may evidently be put together of spherical particles, arranged four and four above each other; but this is not the form which simple spheres are *naturally disposed* to assume, and, consequently, this hypothesis alone is not adequate to its explanation."

This theory is in some respects far superior, in simplicity, to that of the Abbé Haüy. Instead of several different forms of molecules, and a distinction between proximate and integrant molecules, Wollaston's theory supposes the existence of but one varying solid, the spheroid—of which the sphere is properly a variety—and this hypothesis is found fully sufficient for the production of every form presented by inorganic nature.

Yet it is manifest, that this theory must have received very sparingly the attention of the philosophic mind of Dr. Wollaston. The cube and rhombohedron are similar solids, differing merely in that the latter is oblique. It is surely improbable, then, that their atomic arrangements should be as different as Dr. Wollaston's theory supposes; or with reference to the cube alone, that its formation, or even the explanation of it, should require the presence of two kinds of particles. The inquiry still remains, What is the power which aggregates these spherical molecules in forms so regular, bounded by planes so constant in their interfacial angles? Is it true, that the aggregation of spheres represented in the octahedron, (fig. 134,) is, more than any other, the "*natural grouping*" of molecules?

66. Other theories have been proposed on this subject; but only one seems to require a notice in this place, before entering upon that which appears to afford the best explanation of the phenomena. I refer to the *Chemical* theory, as it may be called, since the expla-

nation of chemical facts are usually explained by a reference to its principles.

According to this theory, the atoms of the elements are either spheres or spheroids, and the molecules of compounds result from a juxtaposition of the elementary atoms. These elementary atoms, moreover, are so arranged, that the compound molecule has the shape of the *primary form* of the compound.

We may first remark, that a theory is required to explain the occurrence of solids of definite dimensions and constant angles, exhibiting a perfect symmetry in their several parts, and an exact regularity in the occurrence of secondary planes. In order, therefore, that the similar parts of a crystal should be similarly modified, there should be a corresponding similarity in the different parts of a molecule. The molecule of the cube, besides having the form of a cube, should present a uniformity of character on its six opposite parts, corresponding to the faces of the cube. For these molecules must be of such a nature, that, by their action, similar parts of a crystal should have a similarity in hardness and other physical qualities, and the dissimilar parts, a dissimilarity in these particulars.

Such molecules cannot be formed by the *juxtaposition* of the elementary atoms. An atom of sulphur, the primary of which is the *rhombic octahedron*, united to an atom of lead, whose primary is the *regular octahedron*, could not in any way be made to receive the cubic form of galena; nor, were the molecules equal spheres, would it be a less difficult task—at least eight equal spheres would be required. The molecules of sulphuric acid and lime could not, by any mode of juxtaposition, give rise to a right rhomboidal prism, and especially one of exactly the proportional dimensions and angles of the primary of gypsum; or, if the form were possible, still it would not contain similar atoms in its similar parts, and could not possess that symmetrical character necessary to account for the regularity in the occurrence of similar secondary planes on corresponding parts.

The chemical theory is equally unsatisfactory, in all attempts to account for crystallographic phenomena. Indeed, it may be considered as formed *merely* for chemical purposes, though even here, if carried out, it would prove to be no less imperfect. In the explanations of optical phenomena, it has been rejected by the principal theorists, who, in accounting for the double refraction of crystals, suppose the molecules to have ellipsoidal forms and a homogeneous structure.

Without prosecuting farther the history of the science of Crystallogeny, I proceed to explain what is conceived to be the true nature of molecules and molecular action in the formation of crystals; and, in treating of this subject, I shall *first* examine into the forms of crystalline molecules, and the nature of crystallogenic attraction; *second*, the laws by which molecules aggregate themselves in the

construction of the primary solids; *third*, the formation of compound crystals; *fourth*, the formation of secondary planes; *fifth*, the influence of extraneous causes, producing distorted crystals, and aggregated crystallizations.*

THE NATURE OF CRYSTALLINE MOLECULES.

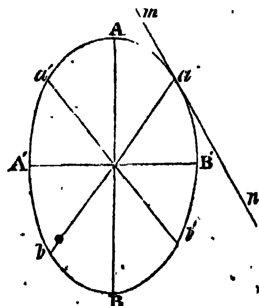
67. By *crystalline* molecule is understood, the molecule in the state peculiar to it, when about to enter into the constitution of a crystal, or when a constituent part of a crystal. Evidently, some important change takes place in the molecule at the time of crystallization. The moment before, they are in close connection, but move freely among themselves: in the act of crystallization, they unite, almost instantaneously, and are firmly compacted in the hard, unyielding crystal.

Forms of Molecules.

68. We adopt, in part, Wollaston's theory of spherical and spheroidal molecules, and suppose the molecule of each primary to be that spheroidal body, or ellipsoid,† which, described within the prism, touches the centres of its faces. These molecules, by their aggre-

* The following views on crystallogeny were first read before the Yale Natural History Society, March 3, 1836, and published in Vol. XXX, p. 275, of the American Journal of Science, in an article on the Formation of Compound or Twin Crystals.

† The following remarks are made in explanation of the solids, termed ellipsoids, or solid ellipses, and their conjugate axes and diameters.



AA′ BB′, is a plane ellipse. A′B′, AB, two lines crossing at right angles, are termed its *conjugate axes; a′b′, ab*, its *conjugate diameters*. The relative situation of these *conjugate diameters* is such, that if a line (*mn*) be drawn, touching the ellipse at *a*, the extremity of one diameter *ab*, it will be parallel to the other *a′b′*. When *ab* and *a′b′* are equal, they are termed the *equal conjugate diameters;* when they intersect at right angles, they are, as stated above, the *conjugate axes*.

The revolution of a plane semi-ellipse, AB′B, around one axis, describes the surface of a solid, which is denominated an ellipsoid of revolution. Let the semi-ellipse AB′B revolve on AB as an axis, all the sections of the described solid, passing through AB, will be ellipses, of the same curvature as the above plane ellipse, their curvature being determined by that of AB′B. Again, as every point in the curve AB′B, describes a circle in its revolution about AB, the sections parallel to the plane described by A′B′, or at right angles with AB, are circles, and, consequently, the lateral axes which lie in the section A′B′, are equal. The ellipsoid of revolution has, therefore, its sections in one direction, *circles*. If these sections are ellipses, the solid is still an *ellipsoid*, but *not one of revolution*, as the simple revolution of a plane ellipse will not describe it.

The axes of ellipsoids are three, and intersect at right angles. The three conjugate diameters are any lines so drawn that a plane touching the ellipsoid at the extremity of one, is parallel to the plane in which the other diameters are situated. Each face of a prism, which touches the ellipsoid at the extremity of one crystallogenic axis, is necessarily parallel to the plane in which the other two axes are situated, (figs. 1, 3, 7, Plate III.) Consequently, the crystallogenic axes, (lines connecting the centres of opposite faces,) are always the conjugate diameters of the ellipsoid, and, if they intersect at right angles, are called conjugate axes.

gation, will build up the same forms as proceed from the aggregation of Abbé Haüy's polyhedral molecules; for they have the same proportional height, breadth, and thickness, and therefore, by combination, must produce a primary of the same dimensions.

Crystallogenic Attraction.

69. The ordinary attraction of cohesion has been considered adequate to produce the union of molecules in the construction of crystals. This attraction acts, however, in every direction from the centre of the particle, and, as it will cause an addition of particles in no fixed direction, must invariably produce a spherical solid. Proof of this fact is observed in every drop of water, or globule of mercury, whose sphericity results from this kind of attraction. To form solids, bounded by a definite number of surfaces, there must be a definite number of directions for the exertion of the attraction. If attraction is exerted in but one direction, the particles will unite only in this direction, and by their union will form only a single line of spheres; exertion in two directions will, in a similar manner, produce a figure of two dimensions only, that is, a plane; in three directions, a figure of *three* dimensions, or a solid bounded by six faces, as the cube. For the construction of prisms, it is therefore necessary that the mutual attraction of the particles be exerted in three fixed directions in each molecule.

These fixed directions may be denominated axes, and their extremities, poles, the one *north*, the other *south*. In each instance, the axes connect the centres of the faces of the prism; for action in these directions only can produce solids similar to the prisms.

The attraction within a molecule is not supposed to be confined to the extremities of the axes. On the contrary, every portion of the surface exerts attraction. But the attraction is strongest at the poles and weakest at points equidistant between them.

a. Cube. The crystallogenic axes of the cube are three equal lines intersecting at right angles, and hence the molecule is a sphere, with three equal conjugate axes, as axes of attraction, (fig. 1, Pl. III.)

Influenced by these axes, the spheres will combine as in fig. 2, and a cube will be formed in the same manner as by the aggregation of an equal number of cubes.

b. Rt. Square Prism. The length of this prism being unequal to its breadth, and its breadth and width equal, the same must be true of the molecule, and consequently it is an *ellipsoid of revolution*, (fig. 3.) The axes intersect at right angles, and thus have a situation similar to those of the cube; and by their action they will form a solid differing from the cube only in its varying height, that is, a *Right Square Prism.*

c. Rt. Rectangular Prism. This solid has three unequal dimensions, and therefore the three conjugate axes of the molecule are unequal, and the horizontal section is an ellipse. The ellip-

soidal molecule therefore is *not* an ellipsoid of revolution. Fig. 4 is a transverse section of the prism and ellipsoid.

We may consider the molecule of the cube an ellipsoid with three *equal* axes, that of the right square prism, an ellipsoid with but two of its axes equal, and that of the right rectangular prism, an ellipsoid with three unequal axes.

d. Rt. Rhombic Prism. Fig. 5 exhibits a horizontal section of this prism and its molecule. The molecule is similar to that of the rectangular prism, but its lateral crystallogenic axes, which connect the centres of opposite faces, are obliquely inclined to one another; and being *equal*, are the *equal* conjugate *diameters*, instead of *conjugate axes*. The vertical axis, as in the preceding prisms, is still one of the conjugate *axes*. The same is the fact with the

e. Rt. Rhomboidal Prism. Its lateral axes are, however, *unequal*, (fig. 6,) and may be any unequal conjugate diameters of the ellipsoid, at right angles with the vertical axis.

f. Rhombohedron, Oblique Rhombic, and Rhomboidal Prisms. In the oblique prisms, the vertical axis is inclined, and is not therefore one of the conjugate *axes*, but a conjugate diameter to each of the lateral axes, which are also conjugate diameters. The lateral conjugate diameters are equal in the rhombic, but unequal in the rhomboidal prism. In the rhombohedron, the lines connecting the centres of opposite faces are equal, and consequently the ellipsoid is one of revolution, and the three crystallogenic axes, its *equal conjugate diameters*, figs. 7, *a*, and 7, *b*. The dotted letters in the above figures are supposed to be situated on the back faces.*

70. A comprehensive view of the molecules and their axes is given in the following table:

Prisms, all of whose cryst. axes intersect at *right* angles, and are therefore conjugate *axes* of the ellipsoidal molecule	axes equal—*Cube.* two only equal—*Rt. Square Prism.* the three unequal—*Rt. Rectang. Prism.*
Prisms whose *lat.* axes are obliquely incl. and are therefore conj. diam. (not axes) of the molecule	lat. axes *equal* conj. diam.—*Rt. Rhombic Prism.* lat. axes, *unequal* conj. diam.—*Rt. Rhombdl. Prism.*
Prisms, all of whose axes intersect at *oblique* angles, and are therefore conj. diam. (not axes) of the molec.	the three axes, equal conj. diam.—*Rhombohedron.* two lateral axes, eq. conj. diam.—*Ob. Rhombic Prism.* the three axes, uneq. conj. diam.—*Ob. Rhdl. Prism.*

From this table it is apparent, that all possible positions of these diameters occur in the forms of crystals, from an equality and rectangularity in the cube, through different variations in length and situation, to a general inequality in length, and a like inequality in their mutual inclinations, as in the oblique rhomboidal prism.

---

* The Rhombohedron thus formed differs materially from that proposed by Wollaston, (fig. 128.) The molecules influenced by these axes, will take an arrangement similar to that in the cube and other prisms.

Moreover, we perceive that all the prismatic primaries may proceed from one simple solid, an ellipsoid, (a sphere being an ellipsoid with equal rectangular axes,) and all may result from a variation merely, in the length and direction of the conjugate diameters of this solid. The simplicity which this view of the subject gives to the whole science of crystallography, is obvious.

With respect to the primary octahedrons and dodecahedrons, it is probable that the regular octahedron and dodecahedron are formed from the axes of the cubic molecule, so modified as to produce a cleavage parallel to their primary faces; also that the other octahedrons contain the same molecule as the prisms of the same bases. It has already been remarked that right rhombic prisms often admit of cleavage parallel to one of the diagonals. A similar occurrence in the cube would give rise to a rhombic dodecahedron as the result of cleavage.

71. It has been stated that the axes of attraction have polarity. We have not the means as yet of determining in every instance which are the North, and which the South poles of a crystal. It may however be inferred, with reference to the rhombohedron, that the three poles about each vertical solid angle are of the same name, those about one, *North*, and those about the other, *South*. In crystals of tourmaline there is then some correspondence between the crystallogenic poles and those induced by heat. Probably also in the oblique prisms, the poles about a dominant solid angle are of the same kind. It is also probable that the poles about an acute edge in the right prisms are of the *same* kind, as marked in fig. 5. Farther than this, it is impossible to distinguish the poles of the axes in the different primaries.

LAWS GOVERNING THE CRYSTALLINE MOLECULES IN THE FORMATION OF THE PRIMARY SOLIDS.

72. The molecules of matter in the act of crystallization, are influenced by the usual principles of attraction, *the repulsion of like poles and the attraction of unlike*, that is, two norths or two souths repel, a north and a south mutually attract. There is this peculiarity, however, that *only the unlike poles of similar axes will unite*. An attraction exists between the north pole of the vertical axis of one molecule, and the south pole of the vertical of another; but none between the north of the vertical axis, and the south of a lateral, when the lateral and vertical are unlike axes. No reason can be required for a fact which appears to be so natural a deduction from the general nature of attraction. We should rather be astonished if the fact were otherwise. It also proceeds from the nature of this attraction, that similar axes will by their union form a straight line; that is, will unite as in fig. 9, Pl. III, and not as in fig. 11.

The most probable hypothesis of the process of crystallization appears to be the following: At the time of crystallization, the molecules, leaving the spherical form of the fluid state, (unless the crystalline molecule is a sphere,) assume their ellipsoidal forms, and cotemporaneously their crystallogenic axes. These forms and axes depend on the nature of the elements in the crystallizing compound. Instantly on the assumption of these axes, the union commences. The molecule which first assumes its form, becomes the nucleus, around which those subsequent in their formation aggregate according to the above laws. The result is one of the regular geometrical solids of crystallography.

FORMATION OF COMPOUND CRYSTALS.

1. *Connatal Compound Crystals.*

73. The mutual influence of the molecules causes them to assume the parallel position of figure 9, Plate III, unless some peculiar circumstances operate to prevent it. During the formation of the myriads of crystals which are produced at every process of crystallization, it must be no uncommon occurrence that two molecules, in close proximity, assuming simultaneously their axes, should have the position given in fig. 10, Pl. III. A north and south pole are here adjacent, as in fig. 9; but the north pole of the other axis in one molecule, has the direction of the south pole in the other molecule. There is a natural tendency to an inversion of one molecule, in order that the uniting axes may be in the same straight line; but this tendency is far inferior to the strong attraction exerted between the adjacent north and south poles. The molecules therefore unite as in fig. 11, and constitute, by their union, a nucleus, each half of which acts independently of the other, though in connection with it, and thus produces a compound crystal. To this accident is owing the formation of *compound crystals of the first kind*, (§ 54,) or those which are compounded parallel to a primary face. Fig. 13, Pl. III, represents a crystal of Arragonite thus formed, and fig. 13, *a*, a horizontal section of the same. The planes $\breve{e}$, $\breve{e}$, truncate the acute lateral edges, as may be observed in fig. 13, *b*.

It is obvious that the axes of the molecules which are at right angles with those represented in figure 11, (and therefore since they point towards the observer, cannot be represented,) may either present their *similar* poles in the same direction, or by the inversion of one molecule, *opposite* poles may point in the same direction, as is the case with the parallel axes in the figure. There are therefore the above two methods of forming compound crystals of *the first kind*. In the *right* rhombic prism, however, both these methods produce the same result, as it matters not whether we invert one of the prisms, (fig. 130, Pl. II,) or whether we change the lateral face,

by which one is united to the other, without inversion. But in *oblique* prisms the difference of structure will be apparent.

We here perceive that those accidents, to which molecules governed by axial attractions are necessarily liable, actually take place in nature; and they afford strong presumptive evidence of the truth of the theory proposed to account for them. Did they not occur, we might very properly conclude that the crystalline molecules were governed by some other force distinct from attraction in fixed axial directions.

74. In the formation of other compound crystals, two molecules unite in points of equilibrium of attraction between *two* poles, and thus give rise to twins of the ***second kind;*** or in similar points between three poles, producing twins of the ***third kind.*** In the first case, the situation of the molecules is that given in fig. 12, Pl. III, where they are retained in combination by the action of two north poles of one molecule, on the two south poles of the other. It is obvious that this is an instance of composition parallel to an edge, as the edges in the primary forms lie opposite the point of equilibrium of attraction between two poles. This is shown by the rectangular figure described about the molecule.

In the second case, the combination is due to the action of three poles of one molecule on three opposite of the other, and consequently the composition is parallel to a plane on an angle.

These accidental forms may be considered a consequence of the nature of the attraction. In the action of particles on one another, assuming together their crystallogenic axes, it is not improbable that two molecules should unite elsewhere than at their poles, provided their axial attractions remain balanced.

An example of the second kind of twins is given in fig. 14, Pl. III, which represents a crystal of pyroxene compounded parallel to the edge *ĕ*. The figures of the compound crystals of feldspar, given in connection with the description of that species, (figs. 5, 6,) are representations of other forms resulting by this method: the *similar* poles of the vertical axes lie in the same direction. The composition is parallel to a plane truncating one of the lateral edges, (plane M of Haüy.)

The third kind of twins is exemplified in figs. 15 and 16, Pl. III, the former a delineation of a crystal of manganite, the latter a scalene dodecahedron of calcareous spar. The composition in this last instance is effected parallel to a plane truncating the vertical angle, or at the point of equilibrium between the three north poles of one molecule, and the three south of the other.

75. Compound crystals composed of more than two individuals, arise from the occurrence of the above species of composition parallel to two or more faces, edges or angles, simultaneously. Several of these forms are represented in figs. 3, 5, 6, 8, Pl. IV.

Fig. 1 represents a horizontal section of a crystal of white lead ore, four of whose lateral angles equal 117° 14′, the obtuse angle of the primary rhombic prism, and two equal 125° 32′, twice the

acute angle of the same. In this instance, composition of the first kind has taken place parallel to two faces of the molecule A. The prism which would thus result, is identical in its interfacial angles with those of the crystal under consideration, as a simple calculation will show.

Fig. 2 is a horizontal section of fig. 3, (another crystal of the same mineral,) whose lateral angles are given in fig. 2. Composition of the first kind has here taken place between A and B, and subsequently, though almost consentaneously, C was added by the attractions between the poles represented in contact. In the preceding prism, (fig. 1,) the union of B and C with A, was effected at the *same instant*, but here the addition of C was *subsequent* to the union of A and B, and from this has arisen the equal inclination of C to the other molecules.

In compound crystals thus formed, each face of the prism is a primary plane. The same form may result from the union of A and B merely, without the addition of C, provided the prisms A and B have one of their acute lateral edges—the distant ones—truncated; for the two upper edges in fig. 2 are parallel to the shorter diagonals of A and B, and therefore are also parallel to the truncating plane just referred to. Fig. 2 of the species *Arragonite* (see Descriptions of Species) is an instance of this mode of formation; two of the lateral planes of the prism, are the planes $\breve{e}$, and four are primary planes, M, and the crystal is composed of two individuals, the planes with the letters accented *below*, belonging to one, and those without the accent, belonging to the other. This inference is deduced from the nature of the planes $\breve{e}$, $\breve{e}$, and from the situation of the secondary planes, which evidently do not belong to more than two individuals.

A horizontal section of fig. 6, a crystal of Witherite, is exhibited in the outer lines of fig. 4. This prism differs from the preceding in the disposition of its primary angles, which are lettered *a*, *b*, *c*, *d*. The angles *m* and *n*, each equal twice the acute angle. To form the nucleus, A, B, and C, D, were first united, and subsequently the compound nuclei AB, CD, were joined by the action of the axes, which are here represented as nearly in contact. This union is stated to be a subsequent act, but the whole was undoubtedly accomplished in a shorter instant than it is within the compass of the human mind to imagine.

When the lateral edges of the component prisms are truncated, as in fig. 13, Pl. III, the cruciform crystal in fig. 5, Pl. IV, is produced, a section of which is given in fig. 4. A similar truncation reduces fig. 1 to the stellated figure represented within it.

In fig. 7, a compound nucleus is represented, in which composition of the first kind has been effected parallel to all the lateral faces of the molecule A. The truncation of the lateral edges of the four crystals, B, C, D, E, would give rise only to a cruciform crystal. But the action of the central molecule A, in conjunction, will cause

an addition of particles parallel to A, and thus produce the other two rays. This is a horizontal section of figure 8, a crystal of white lead ore.

Compound crystals of *the first kind* are most common in rhombic prisms, and especially when the lateral angle is nearly 120°; and if exactly 120°, as is the fact with snow, *simple* crystals are seldom observed. Three molecules, whose lateral axes are inclined at an angle of 120°, form by their union a perfectly compact group, similar to fig. 1, Pl. IV—except that all their axes are united in close contact; and consequently their mutual action produces almost necessarily this compound structure. The union of six molecules by their acute angles, may also take place in the same manner, for 6×60°, (60° is the value of the acute angles when the obtuse are 120°,) equals 360°. This arrangement is probably the origin of most of the stellated crystallizations of snow. Rhombic prisms, whose angles vary much from 120°, do not present this species of compound crystal.

The following are the species in which it is of frequent occurrence: Arragonite (116° 10′,) Strontianite (117° 32′,) Witherite (118° 30′,) White lead ore (117° 13′,) Vitreous Copper (119° 35′,) and Brittle Silver Ore (115° 39′;) and in all other species in which this mode of composition is not observed, the angle differs more from 120° than in those enumerated.

There is one exception to the above remark in the case of *white iron pyrites*, the lateral angles of whose rhombic prisms equal 106° 2′. But this exception beautifully illustrates the general principle. These crystals are composed of five simple crystals, and the angle 73° 58′, (the acute angle of the prism,) is about *one fifth* of 360°. The occurrence of these forms, therefore, corroborates the views I have attempted to explain.

76. In the same manner composition may take place simultaneously on *more than one edge or angle*. The crystals of harmotome are examples of the former. The primary of this mineral is a right rectangular prism, and the relation of this solid to the rhombic prism is such, that particular explanation is unnecessary.

It is an important fact, that those rectangular crystals are more frequently compounded, whose planes, replacing the four lateral edges, incline to one another nearly at angles of 120° and 60°. Such is the case in chrysoberyl.

2. *Postnatal Compound Crystals.*

77. Postnatal crystals are described in § 57, to be of two kinds.

1. Doubly geniculated crystals, or those which have been apparently *bent* subsequent to their formation.

2. Those which are composed of two distinct crystals, united by their similar parts.

Compound crystals of the former kind result from a reversion

of the original polarity in the molecules of the crystal; after the crystal has attained some size. The causes of this reversion are, probably, agents that are not unknown to us. Heat will have this effect on crystals of tourmaline and other minerals, their polarity varying with the temperature. Electricity is equally an efficient agent in producing similar results.

Let AB, (figure 9, Plate IV,) represent a line of molecules in a crystal in the act of formation, with its poles situated as there marked, the marked poles being north. The particle C is supposed to be on the point of obeying its axes of attraction, by uniting the pole *n* with *m*. At this moment there is a sudden reversion of the polarity of the crystal, as represented in A′B′. The molecule C, now finds a repellent pole opposing it—since *m* and *n* are both north—and is immediately drawn around by the attraction between *o*, the nearest south, and *m*, and the union exhibited in A″B″C, takes place, producing a geniculation in the crystal. The process, going on simultaneously at the other extremity of the crystal, causes another geniculation of the same. Fig. 1, under *Rutile*, represents a crystal thus geniculated. Fig. 11, Pl. IV, is a section of a crystal (a little resembling fig. 13, Pl. III) in which there is seen both a connatal and postnatal composition. The latter was effected as above described. Geniculation, according to the second kind of composition, may be illustrated by means of fig. 10; AB is again the crystal, C the next particle to be added. The molecules are those of a right square prism, which form is peculiarly subject to these accidents. In the figure, these molecules lie on one of their sides, and only one lateral axis is seen, the other directing its north pole, *s*, towards the observer. The union of *m* and *n* is again prevented by a reversion of the polarity; *m*, therefore, attracts the nearest north pole, which is *s*. A revolution of 90° must hence take place. But during this time, the unlike poles, *t* and *u*, (the vertical of the prism,) are acting on one another and tending towards a union; consequently, the molecule will assume the intermediate position seen in A″B″C, in which, contact has taken place at the point of equilibrium between two poles.

A similar composition could not occur in the right rectangular prism; for, *s* could not be united to *m*, since they belong to unlike axes, and consequently, there must be a revolution of 180°, to bring *r* into union with *m*. We hence see why the right square prism is particularly subject to this kind of geniculation.

An explanation of a postnatal geniculation, according to the third kind of composition, is not easily given, on account of the number of axes engaged, and the consequent difficulty of representing it in a figure. It flows readily, however, from the above. An example of the same is given in fig. 12. If *e*, *e*, in this figure, were the primary planes, it would be an instance of geniculation according to the *second* kind of composition.

78. The remaining kind of compound crystal, is represented in

fig. 9, of the species *quartz*. It is perfectly analogous to the ordinary union of two molecules; for the crystals are united by their similar parts of opposite polarity, and have their similar faces parallel. They were, probably, brought originally into this parallel situation, by a process analogous to electrical induction, or the mutual action of their attracting influences. We here discover an interesting analogy between electricity and crystallogenic attraction.

FORMATION OF SECONDARY PLANES.

79. When the axes act in their natural state, that is, unmodified in their strength of attraction, the only result is one of the primary solids. The force of attraction in the direction of the axes of any molecule, is inversely proportioned to the lengths of the axes; that is, representing the axes by a, b, c, the force of attraction in the direction of each will vary, as

$$\frac{1}{b} : \frac{1}{c}, \quad \text{or} \quad 1 : \frac{a}{b} : \frac{a}{c}$$

If these axes are modified in their attractions, or if the relation between the intensity of attraction and length of axes is changed, some corresponding change must take place in the form of the solid resulting from their action, or, in other words, secondary planes must be produced.

The laws for the occurrence of secondary planes, (§ 28,) are a necessary sequence, from the very natural principle, that *similar axes must be similarly and simultaneously modified.* The same cause which is effectual in modifying one, must have the same influence on all similar axes. For this reason, all the edges or angles of a cube are simultaneously truncated. Also, the lateral edges of a right square prism are simultaneously truncated; but they are not necessarily accompanied by a replacement of the terminal edges, because this requires, in addition, a modification of the vertical axis, which is unlike the other two, and which therefore is not, of consequence, affected by the same cause. Hence we have the general principle, *dissimilar parts of a crystal are independently replaced.*

Again, one of two beveling planes is accompanied, (excepting the few instances of hemihedrism,) by the other; for the same cause that will produce a plane inclining towards one of two similar axes, will produce a corresponding one inclining at an equal angle to the other. The same principle requires also six intermediaries on each angle of a cube, and but two on those of the right square prism.

In the rhombohedron, (fig. 7, *a*, or 7, *b*, Pl. III,) the plane truncating the terminal angle may be considered as touching the molecule at the point of equilibrium of attraction, between the three poles N, N, *N*, or the three S, *S*, *S*; the planes truncating the terminal

edges touch the same, in a similar point, between the pairs of N s, or pairs of S s ; those truncating the lateral edges, similar equilibrial points between N'', S' ; S', N''' ; N''', S'' ; S'', N', &c. ; that is, a north pole of one extremity, and a south at the other.

Thus, in all the primary forms, we find a perfect correspondence between the occurring planes and the above principles.

The hemihedral modifications of crystals do not militate with the general theory, but merely evince that other powers operate on matter, besides crystallogenic attraction. From the electrical nature of most of these hemihedral crystals, it may be plausibly conjectured that they owe their peculiarities to some peculiar character of the molecule. From § 54 it is apparent that the hemihedral character of a crystal is manifested not only in its modifying planes, but also in its compound crystals. This fact seems to prove that the cause of hemihedrism is some permanent peculiarity of the molecules, and not a mere temporary modification like that producing the generality of secondary planes. We may conjecture that this peculiarity has some connection with electrical polarity, inasmuch as all hemihedral crystals possess preëminently pyro-electric properties. Tourmalines are, in most instances, hemihedrally modified, (see fig. 4, of the species tourmaline,) and as invariably, when heated, exhibit electrical polarity. Boracite, electric calamine, topaz, rhodizite, &c. are in the same manner electric, when heated. The north pole is in general the most highly modified with secondary planes.*

DISTORTION OF CRYSTALS AND AGGREGATED CRYSTALLIZATIONS.

80. If the intensity of attraction in the direction of any one axis is independently increased, the addition of particles will take place in the line of this axis, and the crystal will be lengthened in that direction, without any change in its interfacial angles. This occurs independently of the formation of secondary planes, since these require a *mutual modification* of the *two* or *three* axes between which they are situated. Cubes are often lengthened thus into right square or right rectangular prisms, rhombohedrons into oblique rhombic or rhomboidal prisms. Prismatic crystals often shoot out to a great length, when the actual length of the primary, compared with the breadth, is small. Such are many saline crystallizations.

In general, these crystals are attached to some object by one of the poles of the lengthened axis, and seem to derive this increase of

---

* The tetrahedron has not been included among the primary forms, since it is a result of a hemihedral modification of one of the monometric primaries. The irregular tetrahedron which occurs in some copper ores, and is a secondary to the right square prism, might be ranked with the primary forms, with as much propriety as the regular tetrahedron. It evidently proceeds from the same kind of modification in the attraction, that produces the dissimilarly terminated crystals, or three-sided prisms, of tourmaline, &c.

attracting power from the nature (electrical ?) of their support. Fig. 8, of the species *quartz*, represents a distorted crystal of quartz; fig. 5, of calcareous spar, an equally distorted scalene dodecahedron of this species, which form is here entirely disguised by the undue extension of the crystal in the direction of the axis by which it was attached. The primary faces R, R, together with the planes e', e', the opposites of R, R, and the opposites of e', e', form an eight-sided prism, which is terminated by a small plane R′, and the remaining reduced faces of the dodecahedron. The crystal was attached to the rock by the face R, and is consequently lengthened in the direction of the axis which meets this face. Crystals of quartz are usually attached by the three axes about a vertical angle, and therefore arise perpendicularly from their support, sometimes to a great length. A similar cause will produce crystals which are very short in the direction of the vertical axis.

Fibrous crystallizations have a similar origin. They usually occur as veins in rocks; the attraction in the opposite sides of the vein causes a large deposition of crystals, and their rapid elongation across the vein. Occasionally, they are found on surfaces not having, like veins, a corresponding parallel; in which case, the great rapidity of the crystallization, induced by the electrical influence of their support, has caused the formation of closely compacted crystals, or, in other words, the fibrous structure. The fibres composing this structure, when thus formed, are often regularly terminated with crystalline faces.

The particular pole by which a crystal is attached to its support, probably, depends on the electrical state of this support; and from this cause arises the regularity with which crystals are often aggregated. It is quite probable that future investigations with regard to the positions of crystals in rock strata, especially in granite and allied rocks, will prove that the electric currents in constant circulation around the earth have been active agents in determining the direction in which the axes of crystals lie, and the course of cleavage planes. The curved crystallizations of ice on plants, noticed in § 42, may owe their curves to the electric currents passing from the plant, and circulating around it, and that on the stone wall, to the direction in which similar currents pass from the edges of the stones into the atmosphere.

ISOMORPHISM.

81. The isomorphism of certain substances must be attributed to some similarity in the nature of the molecules, in consequence of which, they produce, in their combinations, compound molecules of similar ellipsoidal form and similar axes. Lime and protoxyd of iron are thus allied, and the qualities of their molecules are so alike, that, on uniting with the same substance in like proportions, the

compound molecule has nearly or quite the same form, and similarly arranged axes.' Dr. H. Kopp has lately shown that isomorphous bodies have equal atomic volumes, and draws the conclusion that isomorphism is owing to an equality in the volume of the atoms, or plesiomorphism, to an approach to equality. Those bodies that replace one another without changing the crystalline form, have atoms of equal volumes, and their isomorphous compounds are also equal in atomic volume. He obtains the atomic volume by dividing the atomic weight by the specific gravity, and thus shows for a great number of the acknowledged isomorphous or rather plesiomorphous minerals, a close approach to one another, in the volumes of their atoms. For example, for the carbonates of zinc and magnesia, mesitine, carbonates of iron and manganese, dolomite, and calc spar, he found the atomic volume as given in the following table:

	Atomic volume.	Axis *a*.	Angle.
Carbonate of Zinc,	175.33	0.807	107° 40
Carbonate of Magnesia,	181.25	0.812	107° 25
Mesitine,	186.26	0.815	107 14
Carbonate of Iron,	188.50	0.819	107 0
Carbonate of Manganese,	202.29	0.822	106 51
Dolomite,	202.36	0.833	106 15
Calc Spar,	231.20	0.854	105 15

The above table, which contains also the axis *a*, and the angle of the rhombohedron, of each of these minerals, illustrates the interesting fact, which he next deduces, that the axis increases, or the angle diminishes, as the atomic volume increases. He also derives a formula for calculating the volume from the length of the axis, and finds it to give results coinciding very nearly with the above. These principles are illustrated by numerous examples, for which reference may be had to Brewster's Philosophical Magazine for April, 1841, p. 255.

Since an increase of atomic volume is connected in the above minerals with an increase of the axis *a*, and heat, by diminishing the density, necessarily increases the volume of the atom, therefore the axis *a* must be lengthened by heat, as is actually the case. Mitscherlich found the specific gravity of calc spar diminished by a heat of 180° F. in the proportion 1 : $\frac{1}{1.001961}$, and Dr. Kopp, by calculation, determines that for 180° F. the angle of the crystal should be changed 7′ 37″, which is but 57″ less than Mitscherlich's observations—a near coincidence, when we consider the difficulties which necessarily accompany the direct measurement of the dilatation and change of angles.

These principles proceed on the hypothesis of simple *spherical* or *spheroidal atoms* for compound bodies, and the theory of atoms proposed by the author receives from them strong confirmation.

DIMORPHISM.

82. Dimorphism has been shown by Mitscherlich, Rose and others to result in many instances from the different temperatures

attending crystallization. When a *right rhombic* prism of sulphate of zinc is heated to 126° F., certain points in its surface become opaque, and from these points bunches of crystals shoot forth, in the interior of the specimen; and in a short time, the whole is converted into an aggregate of these crystals diverging from several centres on the surface of the original crystal. These small crystals thus formed at 126° F., are *oblique* rhombic prisms; and the same form may be obtained by evaporating a solution, at this temperature, or above it. Sulphur crystallizes from fusion in oblique rhombic prisms, while the common form obtained by evaporation is a rhombic octahedron. Rose has obtained crystals of arragonite by evaporating a solution of carbonate of lime to dryness by means of a water bath, and crystals of calc spar by permitting the solution to evaporate in an open vessel at the ordinary temperature. The crystals of arragonite were minute six-sided prisms and double six-sided pyramids, (fig. 121, Plate II.) They change to rhombohedrons of calc spar if left moist; but if washed and dried at once, they remain permanent. By exposing arragonite to a low temperature, the crystal falls to pieces, in consequence of the change to calc spar, which takes place; or if the prisms hold together, they consist after the change, of an aggregate of minute particles of calc spar.* Artificial arragonite has been observed in the interior of a copper boiler used to supply hot water for household purposes at Port Eliot Cornwall. The crystals were minute six-sided prisms, and were attached at base to the surface supporting them.† Breithaupt has described a carbonate of lime from a greenstone rock near Zwickau, which consists of alternations of layers of arragonite and calc spar; and he suggests that the one may be a winter and the other a summer deposit.‡

Dimorphism appears therefore to be owing to the different circumstances attending crystallization. Temperature appears to be the main cause; but it is possible that the nature of the solvent, or the presence of some accidental ingredient in the solution, or the electrical state of the support, may have some effect in changing the molecules; but in general the only effect of these causes is to produce secondary planes. Rose did not succeed in obtaining arragonite crystals by mixing a strontian salt with the solution of lime, and supposes that the strontia in arragonite has nothing to do with producing the rhombic form.

As far as yet observed, one of the forms of dimorphous substances is a right prism, and the other an oblique prism; for the rhombohedron is an oblique rhombic prism with its height and breadth equal.

* Rose, Lond. and Ed. Phil. Mag. 3d ser. XII, 465.
† Lond. and Ed. Phil. Mag. 3d ser. XII, 330—1841.
‡ Pogg. LI, 506—1840.

CHAPTER II.

PRACTICAL CRYSTALLOGENY.

83. A perfect freedom of motion among the elementary particles is an essential preliminary to crystallization. While in the solid state, the attraction of cohesion is already in action, and prevents any other arrangement than that already possessed by the mineral. But when this cohesive attraction is once overcome, they are then at liberty to be influenced by the peculiar attraction of crystallization, and under its influence will assume a crystalline arrangement. There are two means of counteracting this attraction, or reducing the solid to the state of a fluid, each of which is a frequent means of crystallization, both in the laboratory of nature and of art. They are—1. By solution. 2. By heat.

CRYSTALLIZATION FROM SOLUTION.

84. The effect of a liquid solvent, as water, upon the dissolving salt, is to separate its molecules, and destroy their mutual attraction, by means of the attraction which the particles of the liquid have for those of the salt. By solution, we pull down, so to speak, the original structure, and separate its constituent stones, preparatory to a rebuilding of the same. The reconstruction we effect by driving off the antagonist power, *water;* in other words, evaporating it by means of slowly applied heat. Thus free again, the particles can resume their power of attraction and their crystalline nature, and in favorable circumstances, will build up the regular crystal.

Crystallization by this means takes place very differently with different substances. In some instances no appearance of crystallization is apparent till the solution has reached a certain degree of density, when suddenly the whole shoots into a mass of crystals, the water itself entering into their constitution, and forming what is termed the *water of crystallization.*

At other times, after a certain degree of evaporation, the solution, if laid aside to cool, enters the crystalline state as the temperature diminishes.

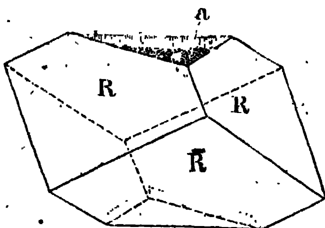
Soon after the commencement of evaporation, small crystals often attach themselves to any prominent object in the containing vessel, and continue their increase with the continuance of the evaporation. In the crystallization of other substances, small crystals, as evaporation proceeds, are observed first to float on the surface of the liquid, increasing gradually in size without changing their forms, until, from an increase of weight, they sink and attach themselves to the bottom of the vessel. Salt affords frequent instances of this process. A very gradual evaporation sometimes produces singular

forms of this mineral. As evaporation goes on only at the surface, there the incipient crystal first appears a minute cube, which presents under the magnifier well defined angles and plane surfaces. Evaporation continues, and as the cube is in contact with the surface of the solution only along its sides, it enlarges laterally without much addition to its thickness. It now sinks so that only its upper edges are exposed to the surface where the crystalline molecules are forming, and consequently these only receive the addition of particles. With every new increase, it continues sinking, at the same time that the particles are added as continually to the upper and outer edge, till finally the result is an inverted hollow four-sided pyramid, which swims like a cup on the surface of the fluid, (figure 137, Plate II.)

Large isolated crystals of the different salts are usually obtained with difficulty. According to Beudant, they may be produced by causing the crystallization to take place in a gelatinous medium.

The depth and quantity of a solution have an influence on the size of crystals; and in general, slow evaporation and a dry atmosphere are most favorable for a deposition of large individuals. Beudant remarks that solutions charged with electricity deposit smaller crystals than when in their natural state. This may account for the different sizes of crystals obtained from similar solutions at different times.

85. A temporary interruption in the process of crystallization, is often indicated by some peculiarity of structure or variation of color. A crystal which has been for a long period removed from a solution, may often be increased in size by returning it to the solution and causing a gradual evaporation. By too rapid evaporation the crystal becomes covered with a deposit of minute crystals, instead of increasing by regularly applied laminæ. Crystals of calc spar from Ecton, in Staffordshire, England, have been described by Brooke, which contained numerous minute crystals of copper pyrites arranged in three concentric layers. They show that there were several intermissions in the formation of the crystals, during which, the copper pyrites was deposited. Still more remarkable instances are met with in the calc spar of Rossie. In one large rhombohedral crystal shown me by Prof. Emmons, the plane a (figure 113, Plate II) could be distinguished within the crystal in consequence of a coating of pyrites. The crystal was originally formed with the terminal angle truncated, after which a deposition of pyrites took place: subsequently to this, lime was again added and the rhombohedron completed; and this took place without an addition of layers to any face except a. Other rhombohedrons of calc spar occur at Rossie, modified with the terminal plane a, which have been enlarged after an intermission, by additions to the *lateral* planes, with *none* to a, and the consequence is, that the plane a is surrounded by an elevated margin or rim. (See the following figure.)



Another singular form of lime is sometimes met with, which illustrates the same principle. It is a six-sided prism with a short tabular prism set like a nail head, on each end. In this instance, after a regular six-sided prism had been formed, the process ceased for a while—probably till some new addition of the calcareous fluid; the crystal then continued its enlargement, but only on the terminal face, no particles, for some reason, being added to the lateral planes. The *cap quartz* is another example of the same intermitted crystallization. Each crystal appears to be made up of a series of caps of the shape of the pyramid, fitting one upon the other. The caps separate from one another at the place in the crystals where the process was interrupted.

Any fluid that will act the part of a solvent, may in general be employed for obtaining crystallizations. Alcohol and ether are often used, and in some instances are the only solvents.

b. In the act of crystallization, the crystallizing mineral often includes more or less of the impurities in the fluid, and this takes place equally in crystallizations from fusion and solution. Calcareous spar is often impregnated with iron, clay, silica, and also with heavy spar, witherite, carbonate, and sulphate of strontia, &c. In this way many mechanical mixtures are formed, which have been mistaken by chemical analysts for distinct compounds. Quartz, in the same manner, often contains silver, copper, chlorite, clay, oxyd of iron, rutile, &c. Whatever the solution contains may thus be mechanically entangled by the segregating particles, and this is no doubt true of all, or nearly all, the mineral species. Alum crystallizing with sulphate of iron, forms octahedrons, which consist almost wholly of the salt of iron. The attraction in the particles of alum may be believed to be stronger than in the vitriol, in consequence of which a skeleton of the former was put together by the action of these attractions, and the vitriol included at the same time mechanically. Dr. Beck suggests that the steatitic spinels of Orange Co., New York, which contain but a small proportion of true spinel disseminated through steatite, have been formed in the same manner. This may have been the case. We deem it more probable, however, that they are spinels more or less perfectly altered to steatite by chemical changes, induced through the agency of heated magnesian waters, when still submerged beneath the ocean.

Many of the included minerals in quartz have crystallized while the silica was still in a pasty state. In this manner it has been permeated by the acicular crystallizations of rutile and many other species. Minute crystals of quartz have often been thus included in larger ones. The same is true of other mineral species.

86. We are acquainted with but few of the means of solution

employed in nature. Water saturated with carbonic acid is a frequent solvent of carbonate of lime, owing to the solubility of the bicarbonate of lime; and by this means the usual stalactites of this mineral are formed, and extensive layers of limestone have been deposited. Water at a high temperature, especially if holding soda or potash in solution, and under pressure, will dissolve silica. A large tract of land in Iceland has been entirely deprived of vegetation by the deposition of silica from the geysers of that volcanic country.

Silica has also been observed in solution and in a soft gelatinous state, in the cavities of rocks. M. Ripetti gives an account of a remarkable cavity at the Carrara marble quarries, which contained about a pound and a half of liquid. "With still greater astonishment *they saw at the bottom of the cavity a transparent protuberance as large as the fist, and which seemed to have all the characters of rock crystal.* Transported with the idea that he was about to possess himself of the purest specimen of hyaline quartz in the world, he instantly attempted to detach it from its matrix; but he had scarcely withdrawn his hand from the cavity, before he saw an elastic and pasty substance, which at first might have taken any shape, and received any sort of impression. It soon, however, became solid and opaque, when it had the aspect of chalcedony, or of a fine porcelain biscuit."* M. Ripetti notices other instances which fell under his own observation. A case little less remarkable was discovered in this city, (New Haven,) by Mr. B. F. Northrop, while breaking some ballast stone, thrown ashore from a vessel from New Orleans. The fluid soon evaporated, as the day was hot, and "minute prismatic crystals shot from the fluid even under the eye of the observer." In another pebble was found a pulpy, gelatinous mass, soft and impressible, which soon dried and afforded a few crystals.† Hollow balls of hornstone containing a milky fluid, are stated to be of frequent occurrence in Georgia, especially on Brier Creek, a stream which passes through Millhaven, and flows into the Savannah river.‡

Count Bournon describes a case in which the mineral in solution was carbonate of lime. The same calcareous solution has been observed in crystals of quartz, as well as calc spar, from New York; and an instance is related of a loose crystal of carbonate of lime, situated within a quartz crystal. Crystals of heavy spar and fluor, containing solutions of these minerals in cavities, have been described by Mr. W. Nicoll. The liquid from the cavity in the crystal of heavy spar soon evaporated on exposure, and afforded crystals of this mineral, nearly equal in bulk to the bulk of the liquid; the crystallization was not complete, however, until after the lapse of twenty-four hours. The fluor spar cavity was partially opened, when the fluid oozed out by its own expansion, indicating a degree

* Brewster's Edin. Jour. X, p. 26. † Silliman's Jour. VIII, 283.
‡ Silliman's Jour. VIII, 285.

of pressure in its confinement. For several hours there were no indications of crystallization; but the next morning several cubic crystals of fluor were distinctly visible immersed in the fluid. The crystals daily increased in bulk, and were not completed under a fortnight.*

Other instances of solutions similar to the above might be enumerated, but they do not tend to any farther elucidation of the subject. It is to be hoped that those who may hereafter be so fortunate as to meet with instances of mineral solutions, will bestow every attention and care in their examination, in order to arrive, if possible, at a clearer explanation of this subject. We cannot doubt that the greater part of the finest quartz crystals in nature have proceeded from solutions; for these crystals often occur occupying cavities in rocks whose origin was evidently not igneous. Such are the crystals so abundant in various parts of the State of New York. We may obtain some idea of the vastness of some of these processes in nature, from the fact that about a century since a drusy cavity was opened in Europe, at Zinken, which afforded 1000 cwt. of rock crystal; one crystal weighed 8 cwt., while others varied from 4 to 5 cwt.

b. Crystals of quartz form an essential part of the epidermis of many grasses, and a variety of chalcedony called tabasheer is often formed about the joints of the reed in India.

Oxalate of lime occurs in crystals, both in the bark and wood of many trees. The chestnut, locust, hickory, oak, mahogany, lignum-vitæ, and many other woods, have been examined by Prof. Bailey, of West Point, and found to afford them in great numbers. In the ashes of the leaves of many trees, every ramification of the vascular fibres was found marked by rows of crystals. A square inch of the inner bark often contains, according to Prof. Bailey, at least a million of these crystals.† The Phytolacca decandra, Mesembryanthemum deltoïdes, the tubercles of the Florence Iris, are among the herbaceous species that abound in crystals of oxalate of lime; they vary in length from one third to one two-hundredth of a millimetre. Other crystals were observed by Prof. Bailey, but their composition has not been determined.

CRYSTALLIZATION BY HEAT.

87. In this process, heat is the divellent force by which the original arrangement of the particles is destroyed, and that freedom from mutual restraint obtained which is necessary for crystallization. By a reduction of the temperature, or a removal of the antagonist power, heat, the particles are again permitted to assume their crystalline nature, and their respective positions in the structure of a crystal. Every winter's day affords us innumerable in-

* Jameson's New Edinburgh Phil. Jour. 1828, p. 97.
† Silliman's Jour. XLV, 149.

stances of this process, when the removal of the heat which retains water in a fluid state, allows the particles to combine by their mutual attractions, and cover streams with extended sheets of ice.

a. Crystals are sometimes obtained by fusion and sometimes by evaporation. To obtain fine crystals by fusion, requires often much care. In case of sulphur, and several of the metals, the most effectual method consists in pouring off the central portion of the fluid mass, soon after a crust has formed, by cooling, on the surface. Bismuth may, in this manner, be obtained in fine crystals. But this means of crystallization is less within the control of art than the preceding.

b. Many substances crystallize directly from a gaseous state. The crystalline deposits of sal ammoniac and sulphur, in volcanic districts, are often thus produced. A more common example is the formation of snow, every flake of which is a congeries of minute crystals. This process takes place when the atmosphere, loaded with vapor, is so reduced in temperature, that the particles are no longer restrained by heat from obeying their own inclinations, or, in more correct language, their attractions.

c. Crystallization, by each of the above methods, is often attended with an emission of light. In general, at the first effort of crystallization, there appears an instantaneous and often brilliant flash of light, which, in some instances, is repeated at the commencement of each new crystal. Splendid exhibitions of this kind have been observed by M. Buchner, of Magonza,* during the crystallization of benzoic acid; the discharge of light continued for a half hour. Acetate of potash, boracic acid, and many other compounds, occasionally exhibit this phenomenon.

M. H. Rose observes that the double sulphate of potash and soda, when formed by fusing together equal parts of sulphate of potash and soda, and crystallizing after dissolving the vitreous mass thus formed in boiling water, gives out a spark at the formation of each rudiment of a crystal: yet when these crystals are redissolved, nothing similar is exhibited. The same crystals, when strongly rubbed after being taken from the water, become phosphorescent. No light appears on crystallization if the vitreous mass is dissolved more than 24 hours after its fusion. The double chromate of potash and soda, exhibits, according to Rose, very lively phosphorescence; and so also does the selenate of potash and soda. Rose's observations have led him to conclude that this light is due to the passage of a salt from one isomeric state to another. The sudden incandescence of oxyd of chromium, titanic acid, &c., when heated, he supposes to be owing to an analogous cause.

d. It has been supposed that complete fusion is necessary for the formation of crystals, or the recrystallization of a mineral mass. But

---

* Brewster's Ed. Jour., III, 369.

late observations have shown, that a high temperature without fusion, or even long-continued friction or vibration, will produce the same result. The tempering of steel is a familiar example. The coarseness or fineness of the grain, or, in other words, the size of the crystallizations, may be varied by the temperature, or the mode of tempering, and a bar that is almost impalpably fine, may in this way be changed to one consisting of crystalline plates an eighth of an inch in breadth. In these instances, the particles must have been free to move, as they are entirely rearranged into large crystals. Mr. N. P. Ames, of Springfield, Mass., who has observed numerous interesting facts bearing upon this subject, informs the author, that if a bar of tempered steel, bent in the form of a semicircle, be heated on the inner side, when the heat has reached a certain point, the bar may easily be bent around, and made to curve in the opposite direction. He states that, until the moment when the requisite temperature is acquired, the bar does not yield; but at this moment a change takes place, which is distinctly felt in the hands, and the bar at once bends. He carefully measured the inner and outer curves of the bar, after thus bending it, and found them of the same length as before. This shows that there had been no compression of the particles on the inner side, which would have shortened that side, and therefore, also, that there was actually a removal of particles from the inner to the outer side. He observes, moreover, that the elasticity of the inner and outer sides was the same, which would not have been the case, were the former compressed. By the old method of restoring a warped sword-blade, it was rendered unequally elastic, and would spring more easily on one side than the other; but by the means here explained, the elasticity is perfectly equal on both sides. Here, then, there is a change in the position of the particles throughout the bar, produced by a temperature very far short of fusion. The same experiment was often repeated, and he found that, at every time he bent the steel, the temperature required was a little above that at which it bent the preceding time.

The change which takes place by friction or long-repeated concussion, is probably owing to the combined action of the heat thus excited, and the vibration that takes place. Mr. Ames states instances in which a large bar of iron, used as an axle through a heavy wheel of cast iron, broke square off in the middle, after use for a few months; and in one instance, there were two other fractures on either side of the centre. In these instances, the bar was rendered coarsely crystalline, and was wholly unlike the original iron. The accident which took place in 1842, on the Versailles railroad, was owing to the breaking of an axle, which was rendered brittle by the same cause.

The change which takes place by heating gently certain dimorphous substances, are other examples of a recrystallization without fusion.

88. With our present knowledge, it is impossible to distinguish,

in all instances, the minerals that have been formed by the several methods just described. This subject is beginning to receive important developments from the discoveries in galvanic science. Already Becquerel, Crosse, and Bird,* by the application of a weak galvanic power, have been enabled to crystallize several species which had before defied the powers of art; among these are the sulphurets of several of the metals, quartz, sapphire, carbonate of lime, and many of the pure metals.

The investigations also of Mitscherlich, Rose, and Berthier, on the production of several of the mineral species by heat, have much extended the limits of our knowledge on this subject. Mitscherlich† found in the scoria from different furnaces in Fahlun, Gaspenberg, and various parts of Germany, perfect crystallizations of pyroxene, mica, chrysolite, and also several other compounds which have not hitherto been met with in the mineral kingdom. These were so situated that there could be no doubt that they resulted from the heat of the furnace. Artificial crystals of specular iron presenting the form of a rhombohedron with the terminal angles deeply truncated, have been observed by the same author in a pottery furnace at Oranienburg.‡ Berthier,§ by mingling in a crucible, silica, lime and magnesia, in the requisite proportions for forming pyroxene, and subjecting the whole to a high heat, succeeded in obtaining crystals of this mineral. When the oxygen of the lime and magnesia was in equal proportions, he obtained the ordinary pyroxene; and when in the proportion of one of the former to two of the latter, the product was identical with the variety of pyroxene from Finland analyzed by Nordenskiöld. M. Rose, of Berlin, has obtained similar results. Crystals of feldspar, possessing in perfection the form, cleavage, and other characters of this species, have been observed by Kersten in the furnace of Saugerhausen.‖ This observation is one of peculiar interest, from the general diffusion of this species in rocks supposed to be of igneous origin. Mitscherlich attempted to form this species by heating the mingled constituents, but obtained only a porcellanous or vitreous mass.

To the agency of fire we may safely refer those minerals occurring in primary rocks which have not proceeded from the decomposition of other species, subsequent to the formation of the rock; also those species sublimed by volcanic fires and crystallized in consequence, in or upon volcanic rocks. While those minerals which are peculiar to secondary rocks are in general the result of aqueous solution. The same aqueous mode of formation has operated in the production of many of the species occupying cavities in volcanic and trap rocks. Such is very evidently the origin of the

* Lond. and Ed. Jour. X, 376.
† Ann. de Chim. XXIV, 355.
‡ Ann. des Mines, 1832, I, p. 116. Ann. de Pogg. 1826, p. 630.
§ Ann. de Ch. XXIV, 376.
‖ Ann. de Pogg. Vol. XXXIII, Nos. 21 and 22; Ann. de Ch. LVII, 219.

geodes of chalcedony filling these cavities, as its frequent stalactitic forms and the arrangement of its colors in layers, plainly indicate. Many of the Zeolitic minerals have similarly originated from waters percolating through the rock, and filtrating into the cavities they occupy.

Many of the mineral species, particularly those resulting from the decomposition of other species, cannot correctly be attributed to either of these modes of formation; but are the immediate effect of decomposition. For example, the crystallized alum found in volcanic district is the result of a crystallization immediately following the union of the constituents, one of which, the sulphuric acid, originates from volcanic action. Gypsum is another frequent instance of this mode of formation. Under the same head should be included many of the metallic salts which proceed from the decomposition of other ores of the metals, and crystallize immediately on their formation, without a previous solution.

CAUSES OF SECONDARY PLANES.

89. Beudant, in his Treatise on Mineralogy,* in which this subject has received some attention, states as the principal cause of secondary planes, *the nature of the solvent, and of the substances it holds in solution.*

He remarks, that when the solvent contains, *mechanically* suspended, minute particles of foreign matter, the crystals formed contain more or less of these foreign particles regularly arranged, either in concentric layers with the laminæ of the crystal, or in the direction of a diagonal, or occasionally intermingled without regular order; and that the crystals thus impure, are *more simple* and regular than those obtained from a clear liquid. Crystals of quartz are seldom perfectly regular bipyramidal prisms, except when they contain large portions of chlorite or oxyd of iron. But if the solvent contains other substances in *solution*, either solid, liquid, or gaseous, secondary forms are usually produced. "Common salt, crystallizing from pure water, presents, almost invariably, a cubic form. But in a solution of boracic acid, it always occurs with truncated angles," (fig. 2, Pl. I.) The Rev. E. Craig, in an interesting article on Microscopic Chemistry, in the Lond. and Ed. Phil. Mag. and Jour. of Science, July, 1836, p. 13, states the following remarkable transformations in crystals of carbonate of copper, produced by a change in the nature of the solvent: "If sulphuric acid be added to carbonate of copper, crystals speedily appear, presenting the form of six-sided tabular prisms. Add a little ammonia, the form is changed entirely to a long rectangular prism with the angles replaced. Add a little more ammonia, and the form changes to

* Traité élémentaire de Minéralogie, par F. S. Beudant, 2 vols. 8vo. 1830; 2d ed.; T. I. p. 189.

several varieties of the rhombic octahedron: a little nitric acid restores again the form of the rectangular prism. In all these successive changes, it is not that a few crystals of another form have been superadded, but each time the metamorphosis is seen to take place in the whole mass."

There are many evidences that the same cause has operated *in nature* to produce the peculiar secondary planes a crystal presents. Arragonite, in iron mines, crystallizes in very acute pyramidal crystals; but in the gypsum clays, accompanying the saliferous deposits, it always appears in prismatic crystals, grouped so as to form hexagonal prisms. Other similar instances might be added; but this will suffice to establish the fact, that secondary planes often arise from the peculiar nature of the solvent.

Another cause may be the electrical state of the rock supporting the crystal, and also its nature. M. Planiava has observed that, in some instances, in which the form of the *floating* crystal was the primary, it assumed secondary planes as soon as it attached itself to the sides of the vessel.* From the nature of crystallogenic attraction, it must be influenced by the electrical excitement of surrounding bodies, and in some circumstances, it may be affected by the electrical state of the atmosphere.

In some instances, secondary planes proceed from some permanent peculiarity in the molecule; for, without this supposition, we cannot account for the invariableness in the occurrence of a particular secondary form of some minerals; for example, the prismatic form in quartz, whose primary is a rhombohedron. From some preceding remarks, the reader may have already deduced, that a certain degree of force of attraction is connected with axes of a certain and definite length, and that secondary planes result from a variation of this relation. With respect, then, to the molecules of quartz, we may conjecture that they are permanently modified in this or some similar manner.†

Very important discoveries would fully repay, beyond doubt, for an extensive series of experiments on this, as yet obscure, subject. From the late rapid improvements in science, we may be encour-

---

* Kastner's Archiv. X, 42; cited in Ferussac's Bulletin.

† Prof. Necker has attempted to explain the origin of secondary planes by the general principle that the tendency in crystals is to assume the form of their molecules. It is apparent that the more complicated the crystal, the nearer is the approximation to a spherical or spheroidal form. Prof. N. conceives that each molecule as well as each solid formed by their union, has different axes of attraction, of different degrees of energy, arranged symmetrically in groups, around the principal or stronger axes of attraction. The effect of obstacles, such as the attraction exerted by mediums, by interposed bodies, by the molecular attraction of the molecules themselves when arriving both in too great numbers and too rapidly towards the same point, will be the annihilation of the weaker axes, and instead of a large number of tangential planes, one at each extremity of each axis, the number is reduced, and by the increase of obstacles, the crystal formed may become a simple solid like the primary forms. According to this theory the tendency in nature is to produce complex forms, and the simple forms are the result of various influences suspending or counteracting the action of the weaker axes.

aged to hope that ere long this entrance to one of the innermost recesses of the works of nature will be thrown open, and that the qualities of atoms, or molecules, their forms and peculiarities, will soon be fully understood. Its connection with the science of chemistry, and other physical sciences, render it deserving of very minute experimental research. Beautifully and truly was it long since remarked by Gulielmini, in his work *on Crystallization*—an author who, though afterwards forgotten, had a clearer insight into the nature of crystallization, than any of his cotemporaries, and many of his successors—p. 144: "Crystallisatio geometrizantis naturæ opus quoddam est, et sane mirabilissimum; dignum ideo ut totis ingenii viribus totâque mentis contentione exquiratur, non quod spectet tantam amœnitatem et voluptatem, quæ mirabilium scientiam consequitur, veram etiam ob maximam in re physicâ utilitatem; videtur quippe Natura hic se prodere, et omni exutâ velamine non qualis esse potest, sed qualis actu est sese præbere conspiciendam."*

* "Crystallization is a peculiar and most admirable result of Nature's geometry, worthy of being studied with all the power of genius, and the whole energy of the mind, not on account of the delight which always attends the knowledge of wonders, but because of its vast importance in revealing to us the secrets of Nature; for here she does, as it were, betray herself, and laying aside all disguises, permits us to behold, not merely the results of her operations, but the very processes themselves."

PART II.

PHYSICAL PROPERTIES OF MINERALS.

CHAPTER I.

CHARACTERS DEPENDING ON LIGHT

90. LIGHT may be either *reflected*, *transmitted*, or *emitted*. The characters of minerals thus produced are of five kinds :—

1. LUSTRE ; depending on the *power* and *manner* of *reflecting* light.
2. COLOR ; depending on the *kind* of light *reflected* or *transmitted*.
3. DIAPHANEITY ; depending on the *power* of *transmitting* light.
4. REFRACTION ; depending on the *manner* of *transmitting* light.
5. PHOSPHORESCENCE ; depending on the *power* of *emitting* light.

LUSTRE.

91. The lustre of minerals arises from the nature of their surfaces, which causes more or less of the light incident upon them, to be reflected. A variation in the *quantity* of light reflected, produces different degrees of *intensity of lustre ;* a variation in the *nature* of the reflecting surface, produces different *kinds of lustre.*

a. The *kinds of lustre* are six, and are named from some familiar object, or class of objects, which exhibits them.

1. *Metallic :* the usual lustre of metals. Imperfect metallic lustre is expressed by the term *sub-metallic.*

2. *Vitreous :* the lustre of broken glass. An imperfectly vitreous lustre is termed *sub-vitreous.* The vitreous and sub-vitreous lustres are the most common in the mineral kingdom. Quartz possesses the former in an eminent degree ; calcareous spar often the latter. This lustre may be exhibited by minerals of any color, and in each case resembles the lustre of broken glass of the color of the mineral.

3. *Resinous ;* lustre of the yellow resins, as benzoin. Ex. opal, and some yellow varieties of zinc blende.

4. *Pearly :* ex. talc, native magnesia, stilbite, &c. When the pearly lustre is also sub-metallic, the term *metallic-pearly* is applied.

5. *Silky:* like silk; it is the result of a fibrous structure. Ex. fibrous carbonate of lime, fibrous gypsum, and many fibrous minerals, more especially those which in other forms have a pearly lustre.

6. *Adamantine:* the lustre of the diamond. When also submetallic, it is termed *metallic-adamantine*. Ex. some varieties of carbonate of lead, and dark red silver ore.

b. The *degrees of intensity* are denominated as follows:—

1. *Splendent:* when the surface reflects light with great brilliancy, and gives well defined images. Ex. Elba iron ore, tin ore, some specimens of quartz and pyrites.

2. *Shining:* when an image is produced, but not a well defined image. Ex. calcareous spar, celestine.

3. *Glistening:* when there is a general reflection from the surface, but no image. Ex. talc, copper pyrites.

4. *Glimmering:* when the reflection is very imperfect, and apparently from points scattered over the surface. Ex. flint, chalcedony.

A mineral is said to be *dull* when there is a total absence of lustre. Ex. chalk, the ochres, kaolin.

These different degrees and kinds of lustre are often exhibited differently by *unlike* faces of the same crystal, *but always* similarly by *like* faces. The lateral faces of a right square prism may thus differ from a terminal, and in the right rectangular prism the lateral faces also may differ from one another. This is an immediate consequence of the fact, that unlike faces are produced by unlike crystallogenic axes.

COLOR.

92. In descriptions of the mineral species, it is usual to notice both the external color, and that which the mineral presents when abraded with a file. The latter is the most important character in distinguishing minerals, for it seldom varies in the same species, though externally the mineral may present many shades of color. The mineral species are liable to so many accidental mixtures of foreign substances, that, in general, little reliance can be placed on the external color. The metals and the metallic oxyds are among those species, which are the least subject to variation.

The color obtained by abrasion, which usually corresponds with that of the powder, is included under the term *streak*. This term includes also the *lustre* produced by abrasion.

The following eight colors have been selected by Werner as fundamental, to facilitate the employment of this character in the description of minerals; *White, Gray, Black, Blue, Green, Yellow, Red,* and *Brown*.

a. Metallic Colors.

1. *Copper-red:* the color of copper; copper—less perfectly, copper nickel.

2. *Bronze-yellow:* the color of bronze; magnetic pyrites.
3. *Brass-yellow:* copper pyrites.
4. *Gold-yellow:* native gold.
5. *Silver-white:* native silver, less distinct in arsenical pyrites.
6. *Tin-white:* mercury, tin-white cobalt.
7. *Lead-gray:* galena, molybdena.
8. *Steel-gray:* nearly the color of fine grained steel on a recent fracture; native platina, and palladium.

b. Non-metallic Colors.

A. WHITE.
1. *Snow-white:* carrara marble.
2. *Reddish-white:* some varieties of calcareous spar and quartz, &c.
3. *Yellowish-white:* some varieties of calcareous spar and quartz.
4. *Grayish-white:* the same examples.
5. *Greenish-white:* talc.
6. *Milk-white:* white, slightly bluish; some varieties of Chalcedony.

B. GRAY.
1. *Bluish-gray:* gray, inclining to a dirty blue color; some varieties of limestone.
2. *Pearl-gray:* gray, mixed with red and blue; horn silver, Pinite.
3. *Smoke-gray:* gray, with some brown; flint.
4. *Greenish-gray:* gray, with some green; cat's eye, some varieties of talc.
5. *Yellowish-gray:* some varieties of compact limestone.
6. *Ash-gray:* the purest gray color; zoisite.

C. BLACK.
1. *Grayish-black:* black, mixed with gray, (without any green, brown, or blue tints;) basalt, Lydian stone.
2. *Velvet-black:* pure black; obsidian, black tourmaline.
3. *Greenish-black:* pyroxene.
4. *Brownish-black:* bituminous coal.
5. *Bluish-black:* black cobalt.

D. BLUE.
1. *Blackish-blue:* dark varieties of blue malachite.
2. *Azure-blue:* bright blue with a little red; pale varieties of blue malachite, bright varieties of lapis-lazuli.
3. *Violet-blue:* blue mixed with red; amethyst, fluor spar.
4. *Lavender-blue:* blue with some red and much gray; lithomarge.
5. *Prussian-blue,* or Berlin blue: pure blue; sapphire, kyanite.
6. *Smalt-blue:* some varieties of gypsum.
7. *Indigo-blue:* blue with black and green; blue tourmaline.
8. *Sky-blue:* pale blue with a little green; the color of the clear sky. It is called mountain blue by painters.

E. GREEN.

1. *Verdigris-green:* green inclining to blue; some varieties of feldspar.

2. *Celandine-green:* green with blue and gray; some varieties of talc and beryl. It is the color of the leaves of the celandine, (Chelidonium majus.)

3. *Mountain-green:* green with much blue; beryl.

4. *Leek-green:* green with some brown; the color of the leaves of garlic; distinctly seen in prase, a variety of quartz.

5. *Emerald-green:* pure deep green; emerald, imperfect in green malachite.

6. *Apple-green:* light green with some yellow; chrysoprase variety of quartz.

7. *Grass-green:* green with more yellow; green diallage.

8. *Pistachio-green:* green with yellow and some brown; epidote.

9. *Asparagus-green:* pale green with much yellow; asparagus stone.

10. *Blackish-green:* some varieties of serpentine.

11. *Olive-green:* pale green with much brown and yellow; olivine.

12. *Oil-green:* lighter green with more yellow and less brown; the color of olive oil; beryl, pitchstone.

13. *Siskin-green:* light green, much inclining to yellow; uranite.

F. YELLOW.

1. *Sulphur-yellow:* native sulphur.

2. *Straw-yellow:* very pale yellow; some varieties of topaz.

3. *Wax-yellow:* yellow with gray and some brown; zinc blende, opal.

4. *Honey-yellow:* yellow with some red and brown; calcareous spar.

5. *Lemon-yellow:* pure yellow; native sulphur, orpiment.

6. *Ochre-yellow:* yellow with brown; yellow ochre.

7. *Wine-yellow:* pale yellow with some red and gray; topaz and fluor.

8. *Cream-yellow:* pale yellow with some red and a tinge of brown; some varieties of lithomarge.

9. *Orange-yellow:* yellow inclining to red; orpiment.

G. RED.

1. *Aurora-red:* red with much yellow; some varieties of realgar.

2. *Hyacinth-red:* red with yellow and some brown; hyacinth, garnet.

3. *Brick-red:* polyhalite, some varieties of jasper.

4. *Scarlet-red:* bright red with a tinge of yellow; cinnabar.

5. *Blood-red:* red with some yellow and black; pyrope.

6. *Flesh-red:* pale red with gray and some yellow; barytes.

7. *Carmine-red:* pure red; ruby sapphire.

8. *Cochineal-red:* red with some blue and gray; light red silver ore.

9. *Rose-red:* rose quartz.

10. *Crimson-red:* red with some blue; ruby.

11. *Peach-blossom-red:* red with white and gray; lepidolite.

12. *Columbine-red:* red with some blue and much black; garnet.

13. *Cherry-red:* dark red with much blue and brown; spinel, some varieties of jasper.

14. *Brownish-red:* jasper, brown iron ore.

H. BROWN.

1. *Reddish-brown:* garnet, zircon.

2. *Clove-brown:* brown with red and some blue; axinite.

3. *Hair-brown:* brown with some yellow and gray; wood opal.

4. *Broccoli-brown:* brown, with blue, red, and gray; zircon.

5. *Chestnut-brown:* pure brown.

6. *Yellowish-brown:* common jasper.

7. *Pinchbeck-brown:* yellowish-brown, with a metallic or metallic-pearly lustre; several varieties of talc, bronzite.

8. *Wood-brown:* brown with yellow and gray; color of old wood nearly rotten; some specimens of asbestus.

9. *Liver-brown:* brown, with some gray and some green; jasper

10. *Blackish-brown:* bituminous coal, brown coal.

c. Peculiarities in the Arrangement of Colors.

Play of Colors. Several prismatic colors appear in rapid succession on turning the mineral. This property belongs in perfection to the diamond; it is also observed in precious opal, and is most brilliant by candle light.

Change of Colors. Each particular color appears to pervade a larger space than in the play of colors, and consequently the succession produced by turning the mineral is less rapid. Ex. Labrador feldspar.

Opalescence. A reflection of a milky or pearly light from the interior of the specimen. It is observed in some varieties of opal, and in cat's eye.

Iridescence. Fixed prismatic colors in the interior of a crystal. It is the effect of fracture.

Tarnish. A metallic surface is tarnished, when its color differs from that obtained by fracture.

A surface possesses the *steel* tarnish, when it presents the superficial blue color of tempered steel. Ex. Columbite.

The tarnish is described as *irised,* when it exhibits fixed prismatic colors. Ex. specular iron ore from Elba. Variegated copper ore is an instance of common tarnish.

Dichroism. Some crystals, viewed by transmitted light, present different colors in different directions. This property is termed

dichroism, derived from a Greek word, signifying *two colors*. This property is exhibited only by crystals which have at least two kinds of axes, and the different colors are observed in the direction of the different axes. It exists in tourmaline, iolite, mica, &c. Mica is nearly opaque in one direction, while it is transparent in another; it also presents different colors in these directions.

DIAPHANEITY.

93. The Diaphaneity of a mineral is its capability of transmitting the rays of light. The following terms are adopted to express the different degrees of this property.

Transparent: when the outline of an object, behind the mineral, is perfectly distinct. Gypsum, quartz.

Subtransparent: when the object is seen, but its outline is not distinct.

Translucent: when the object is not visible, but light is transmitted. Carrara marble.

Subtranslucent: when merely the edges transmit light, or are translucent.

When no light is transmitted, the mineral is said to be *opaque*.

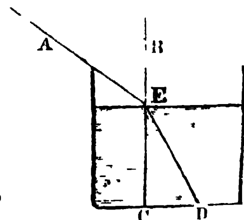
This property occurs in every degree in the mineral kingdom, from a perfect opacity to a perfect transparency, and most minerals present, in their numerous varieties, nearly all the different shades. Few minerals, except the metals, are perfectly opaque.

REFRACTION.

94. A full treatise on the *refraction of light* belongs more especially to a work on optics; the remarks in this place will, therefore, be brief.

a. Simple refraction. If we look into a cup obliquely, at such an angle that an object at its bottom is just concealed from view by its sides, on filling the cup with water, this object will become visible.

This is owing to a bending or *refracting* of the rays of light, by the water. This effect is termed *refraction*, and is produced by all transparent bodies, whether solid, liquid, or gaseous.



The part of the ray AED, within the water, is nearer the perpendicular BC, than if it had proceeded in its original direction AE; or, if we consider the ray as passing from the water into the air, the part, AE, is farther from the same perpendicular than if it had proceeded in the original direction DE. We have therefore this important principle: *Light, in passing from a rarer to a denser medium, is refracted* TOWARDS *the*

perpendicular ; if from a denser to a rarer, it is refracted FROM *the perpendicular.*

It has been proved by experiment, that at whatever angle we look at the surface of the water, there will be a constant ratio between AB and CD, provided the eye and the object are at the same distance, A and D from E. That is, if AB is twice the length of CD, viewing it at one angle, it will be twice at every other angle, until the eye is perpendicular over the object D, when there is no refraction. But AB is the *sine* of the angle AEB, which is the *angle of incidence*, CD, the sine of the angle CED, which is the *angle of refraction*. This principle may therefore be thus stated:

The sine of the angle of incidence bears a constant ratio to the sine of the angle of refraction.

This ratio is termed the index of refraction. In water, the ratio is as 1.336 to 1. 1.336 is therefore the index of refraction of water.

b. Double refraction. A line viewed through a crystal of transparent calcareous spar, (often called Iceland spar, as it was first obtained on that island,) appears to be double. One image is observed by the usual refraction of the light, while the second is perceived by means of an *extraordinary* refraction. If the crystal is placed over a point, and turned around, one image, *that* produced by the extraordinary refraction, will appear to revolve around the other.

This power of producing double images is termed *double refraction.* It may be observed in every direction through a crystal of Iceland spar, except in that of the vertical axis. The vertical axis of the crystal is therefore termed the *axis of double refraction*, since, in its direction, the ordinary and extraordinary ray coincide. Double refraction increases from this axis, where it is 0, to a plane at right angles with it.

In some instances, the extraordinary ray is situated between the ordinary ray and the perpendicular; in others, it is exterior to this ray. The former possess a *greater index of refraction* for the extraordinary than for the ordinary ray, and the axis is called a *positive axis of double refraction.* The latter have a *less index of refraction* for the extraordinary than ordinary ray, and therefore a *negative axis of double refraction.*

All crystals possess the doubly refracting structure, excepting monometric solids, that is, the cube, octahedron, &c., &c. Some crystals contain *two axis* of double refraction, or two directions in which the ordinary and extraordinary rays are coincident, and where, therefore, double refraction is not seen.

We remark, preliminary to an explanation of this distinction of crystals, into those with one axis, and those with two, that the molecule of a right rectangular prism has three principal sections; one through the vertical axis and the longer horizontal, another through the vertical and shorter horizontal, and a third through the two horizontal axes. These three planes of section intersect at right angles, and are called the *axial planes* of the ellipsoid, two

of which are vertical, and one horizontal. With this explanation, we proceed.

If the molecule is an *ellipsoid of revolution*, in which the two vertical axial planes are *equal ellipses*, there is but *one* axis of double refraction.

If the molecule is an *ellipsoid, not* of revolution, in which the two vertical axial planes are *unequal ellipses*, there are two axes of double refraction.

The crystals of one axis are included in the dimetric and hexagonal systems; those of two axes, in the trimetric, monoclinate, diclinate, and triclinate systems.

PHOSPHORESCENCE.

95. Phosphorescence, or the emission of light by minerals, may be produced in different ways: by *friction*, by *heat*, or by *exposure to the light of the sun.*

By friction. Light is readily evolved from quartz, by the friction of one piece against another, and merely the rapid motion of a feather across some specimens of sulphuret of zinc, will often elicit light, more or less intense, from this mineral. Friction, however, will evolve light from a few only of the mineral species.

By heat. Fluor spar is very beautifully phosphorescent at the temperature of about 300° F. Different varieties give off light of different colors; the *chlorophane* variety, a splendid emerald green light; others purple, blue, and reddish tints. This phosphorescence may be observed in a dark place, by throwing the pulverized mineral on a shovel heated below redness. Some varieties of white limestone or marble emit a yellow light, when treated in the same manner.

By the application of heat, minerals lose their phosphorescent properties. But on passing electricity through the calcined mineral, a more or less vivid light is produced at the time of the discharge, and subsequently the specimen when heated will often emit light, as before. The light is usually of the same color as previous to calcination, but occasionally is quite different. The following table contains some of the results of T. J. Pearsall's* investigations: the second column gives the color of the natural phosphorescence; the third, the color induced by electric discharges.

Green fluor from Cornwall.	Rose, ending with orange.	6—12 discharges; bright green, ending with purple, 36 discharges; green, almost as intense as natural.
Green cubes from Wear Dale, Cumberland.	Deep blue and purple.	20—40; greenish, then violet, and finally fine purple.
Pale yellow cubes from Gersdorff.	Green and violet.	12, 24, 36 discharges; yello finally purple.
Massive fluor from Derbyshire.	Dull green and pink, of short duration.	24 discharges; yellowish.

* Jour. of Royal Institution, Vol. I, pp. 77 and 267. Ann. de ch. XLIX, 337.

The light induced by electricity is in general less intense than that of the unaltered mineral, but is much increased by a repetition of the electric discharges, and in some varieties of fluor it may be nearly or quite restored to its former brilliancy. It has also been found that some varieties of fluor, and some specimens of diamond, calc spar, and apatite, which are not naturally phosphorescent, may be rendered so by means of electricity. A dozen discharges through a non-phosphorescing statuary marble in powder, caused it to emit a yellow light when subsequently heated. Electricity will also increase the natural intensity of the phosphorescent light.

Acquired phosphorescence is not equally permanent, however, with the natural. On 21 days of exposure to the light, according to Mr. Pearsall, many specimens lost partially, and some entirely, this property; in others, the color of the light was changed; and generally to purple and orange tints. If laid away in a *dark* room, they retained this property for a much longer period of time.

Mr. Pearsall also states that some colored fluors that had been rendered white by calcination, received a bluish or reddish tint, by means of repeated electrical discharges.

Light of the sun. The only substance in which an exposure to the light of the sun produces very apparent phosphorescence, is the diamond—some specimens seem to be destitute of this power.

CHAPTER II.

ELECTRICITY.

96. The means of developing electricity in minerals, are friction and heat.

1. *By friction.* There is no line of distinction among the mineral species, separating them into those of *resinous* and those of *vitreous* electricity. The same mineral in its different varieties, often presents both kinds, and frequently the two are exhibited by the same specimen. This character is, therefore, of little importance to the mineralogist.

2. *By heat.* The effect of the application of heat on some minerals, is the development of electric polarity. This property belongs, in a remarkable degree, to tourmaline and boracite. These minerals usually occur in hemihedral crystals, the one under the form of a three or six-sided prism, (secondary to a rhombohedron,) differently terminated at its extremities; the other in that of a cube, with its opposite solid angles dissimilarly replaced. M. Becquerel remarks concerning the tourmaline:* "At 30° C, electrical polarity

* Ann. de ch. XXXVII, 1, 1828. Brewster's Edin. Jour. X, 50, 1829.

was sensible; it continued unchanged to 150°, as long as the temperature continued to rise; if stationary an instant, the polarity disappeared; but shortly manifested itself *reversed*, when the temperature commenced to decline. If but one end of the crystal was heated, the crystal was unpolarized, and when two sides were unequally heated, each acquired an electrical state independent of the other."

The most modified end of tourmaline is usually the positive or north pole. The same is true of boracite, whose opposite poles are exhibited at the opposite angles. The powder of tourmaline is also pyro-electric.

The usual method of observing the polarity of tourmaline, is to place the heated crystal on a brass support, which turns on a pivot like a magnetic needle. By presenting the poles of a magnet, it will be found that the north pole of a magnet will attract one extremity of the crystal and repel the other.

The following is a list of the *pyro-electric* minerals, as given by the *Abbé Haüy*, with the names of those who first noticed their pyro-electric properties.

Tourmaline, *Lemery*.	Mesotype.	*Haüy*.
Topaz, *Canton*.	Prehnite.	
Axinite, *Brard*.	Oxyd of zinc.	
Boracite, *Haüy*.	Sphene.	

Brewster has added the following:

Calc spar	Analcime.
Yellow beryl.	Amethyst.
Heavy spar.	Quartz, (Dauphiny.
Celestine.	Idocrase.
White lead ore.	Mellite ?
Fluor spar, (red and blue.)	Sulphur, (native.)
Diamond.	Garnet.
Orpiment.	Iolite.

To these should be added,

Electric calamine.	Euclase.
Rhodizite.	

Hausmann and Heinrici have made experiments on the power of minerals to conduct electricity, and have arrived at the following conclusions:—that the native metals are the best conductors, next the sulphurets, next the oxyds. Lustrous metallic crystals are good conductors, and unmetallic crystals in general, bad conductors. The more metallic sulphurets conduct better than those, like blende, which are imperfectly metallic in lustre. Anatase from some localities is a bad conductor, and from others a good conductor. Rutile is a bad conductor. The diamond conducts electricity badly,

while graphite and anthracite are good conductors. Magnetic iron, titanic iron, and columbite, are good conductors, while chromic iron scarcely conducts electricity at all. Black hornblende and pyroxene are good conductors, and diopside almost an isolator.

The conductility of a crystal is often different in a transverse direction from what it is in a longitudinal.

CHAPTER III.

MAGNETISM.

97. MAGNETIC polarity and attraction is exhibited by only one of the ores of iron. This ore often possesses these characters in an eminent degree, and when arranged in the form of a horse-shoe magnet, will lift very heavy weights.

Several of its ores, however, are *attractable by the magnet*, though not possessed of magnetic powers themselves. This may be observed, by presenting the ordinary steel magnet to the mineral reduced to a coarse powder: if the particles are susceptible of magnetic influence, they will adhere to the applied magnet. The trial may be made with far more delicacy, by bringing the specimen near a suspended magnetic needle, and observing whether it causes the needle to vibrate. This character serves to distinguish a few of the mineral species, which otherwise have very close resemblances; especially, magnetic iron ore from specular iron, and magnetic pyrites from common pyrites. The native magnet is a variety of magnetic iron ore.

The metals *cobalt* and *nickel* are also said to be attractable by the magnet; and Breithaupt has lately shown that *iridium* should be added to the number.

Many minerals become attractable by the magnet, only after undergoing the high heat of the blowpipe; this is the result of a partial decomposition.

CHAPTER IV.

SPECIFIC GRAVITY.

98. The specific gravity of a mineral is its weight, compared with that of another substance of equal volume, whose gravity is taken at unity. If a cubic inch of any mineral weighs twice as

much as a cubic inch of water, (water being the unit,) its specific gravity is 2, if three times as much, its specific gravity is 3, &c. In the case of solids or liquids, this comparison is usually made with water; but when the substance is a gas, atmospheric air is assumed as the unit.

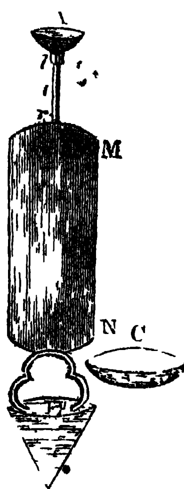
It results from the nature of a fluid, that the weight lost by a solid immersed in water, is equal to the weight of an equal volume of water. The determination of specific gravity is, therefore, a very simple process. We ascertain the weight out of water by weighing it in the usual manner; we then determine the weight in water; and the loss by immersion, or the difference of the two weights, is the weight of an equal volume of water: that is, if a mineral weighs 120 grains out of water, but 90 on emersion, it has lost 30 grains, which is the weight of a volume of water equal to that of the mineral. The mineral, consequently, weighs in this instance, 4 times as much as the water; for 4×30 grains, (weight of water,) equals 120 grains, which is the weight of the mineral. The rule for the process is, therefore, *Divide the weight out of water, by the difference of weights obtained out and in water.*

The water employed for this purpose should be distilled, to free it from all foreign substances. Since the density of water varies with its temperature, a particular temperature has been selected for these experiments, in order to obtain uniform results: 60° F. is the most convenient, and has been generally adopted.

If a pair of scales is used for obtaining the weight, they should be exceedingly delicate, when perfect accuracy is required. For original investigations they should turn with the 1000th of a grain. The weights must be selected with care, and should vary from the twentieth of a grain to 120 grains. To weigh the mineral immersed in water, it may be attached to the scales by a single fibre of raw silk or a fine hair, and thus let down into a jar of water, care being taken that the scales be kept perfectly dry. The attachment of the fibre of silk to the scales, may be made by means of a small hook attached to the lower part of one scale. For the ordinary investigations of the mineralogist, in the determination of species, it will be found most convenient, if the scales are not provided with this hook, to make a small hole through the centre of one scale, and through it attach a horse hair permanently to the scale. By tying a slipping knot in the horse hair, the minerals under investigation may be attached and detached without difficulty, owing to the elasticity of the hair.

An instrument called Nicholson's Aræometer, is often substituted for the scales, and in many cases is sufficiently accurate.

M N is a hollow metallic cylinder; E, a leaden support for the mineral; A, a cup attached to M N by a piece of brass wire, *br*; a mark should be made at *b* on this wire, a short distance above the line to which the instrument sinks, when immersed in water.



In using the instrument it is inserted into a tall glass jar containing water, and the cup C placed on A to receive the weights. The weights are now added until the instrument sinks to the line at b. This weight, which is to be noted and marked on the cup C, is called the *balance weight* of the instrument. It will be perceived as we proceed, that the specific gravity of no specimen of greater weight than the balance weight, can be determined with this instrument, except by changing the position of the mark b.

To ascertain the specific gravity of a mineral, place the specimen on C, and add such additional weights as are required to sink the instrument to b; subtracting this additional weight from the balance weight gives the weight of the specimen. Next, place the specimen on the receptacle E, and having immersed the whole again in the water, add weights to C till the instrument again sinks to b; the weights added, equal the weight of an equal volume of water. We then divide as before the weight of the mineral by the weight of an equal volume of water.

To insure accuracy, those specimens should be selected which are perfectly free from foreign substances, and contain no vacuities. If vacuities exist, they may usually be removed by *coarsely pulverizing* the mineral. An *impalpable* powder is apt to swim on the surface, although heavier than water.

A much better method of determining the specific gravity of porous minerals, is to take a small light glass bottle, containing exactly a thousand grains of distilled water at the temperature 60° F., pour out a few drops and weigh it; then put in the pulverized mineral till the water is again to the brim, and reweigh it: the difference in the two weights is the specific gravity of the mineral.

The mineralogist is so seldom required to take the specific gravity of liquids or gases, that an explanation of the different methods employed is unnecessary.

CHAPTER V.

CHARACTERS DEPENDING ON COHESION.

These characters are of three kinds:—1. Hardness; 2. State of Aggregation; 3. Fracture.

1. HARDNESS.

99. It is a fact of common observation, that we may distinguish a harder body from a softer, either by attempting to scratch the one with the other, or by trying each with a file. Both these methods are used by the mineralogist in determining the hardness of the species, though the latter is in most cases to be preferred. Both methods should be employed when practicable. Certain varieties of some minerals give a low hardness *under the file*, owing either to impurities or imperfect aggregation of the particles, whilst they *scratch* a harder species, showing that the particles are hard, although loosely aggregated. Chiastolite, spinel and sapphire, are common examples of this fact. When the mineral is too hard to be impressed by a file, the peculiarity of the grating sound will suffice to the practised ear.

To give a definite character to the results obtained with respect to the hardness of minerals, the distinguished German mineralogist, MOHS, has introduced a *scale of hardness*. In older works on the science, the very indefinite terms *hard*, *soft*, *tender*, &c., were employed to express the degrees of hardness. Afterwards, minerals were described as harder or softer than glass or than one another. Consequently, the standards were almost as numerous as the mineral species, and no information was conveyed to the person unacquainted with the species with which comparison was made, or if acquainted with the species, since many minerals vary somewhat in their hardness, the statement was still indefinite, unless the particular variety was noted. The confusion and incorrectness thus introduced into the science, have been removed by the selection of a few minerals of common occurrence as standards of comparison. Mohs's scale consists of ten minerals, which gradually increase in hardness from 1 to 10. The intervals between 2 and 3, and 5 and 6, are larger than the others. Breithaupt has therefore introduced another degree of hardness between each of the above, and thus his scale consists of twelve minerals. The advantage of Breithaupt's scale may be secured without altering the number of units of comparison, by numbering that between 2 and 3, 2½ or 2.5, and that between 5 and 6, 5½ or 5.5.

The scale, thus constructed, is as follows:

1. *Talc*, common laminated light green variety.
2. *Rock salt*, or an uncrystallized variety of gypsum.
2.5. *Foliated mica*.
3. *Calcareous spar*; transparent variety.
4. *Fluor spar*, crystalline variety.
5. *Apatite*, transparent variety.
5.5. *Scapolite*, crystalline variety.
6. *Feldspar*, white cleavable variety.
7. *Quartz*, transparent.

8. *Topaz*: transparent.
9. *Sapphire*; cleavable varieties.
10. *Diamond*.

If the file abrades the mineral under trial with the same ease as No. 4, and produces an equal depth of abrasion with the same force, its hardness is said to be 4. If with more facility than 4, but less than 5, the hardness may be 4¼ or 4½, written in decimals 4.25, 4.5. Several successive trials should be made to obtain certain results.

The use of the file is acquired with very little experience; usually a single trial is sufficient. Care must be taken to apply the file to edges of equal obtuseness. That part, also, of the specimen should be selected, which has not been altered by exposure, and has the highest degree of transparency and compactness of structure. The pressure for determination should be rather heavy, and the file should be passed three or four times over the specimen.

Some crystals present different degrees of hardness on dissimilar faces. An example of this fact is observed in kyanite and mica. This is confined to the inequilateral primary forms, and like the similar difference of color, lustre, &c., finds a ready explanation in the theory of their formation: *unlike faces are the result of the action of unlike axes.*

2. STATE OF AGGREGATION.

100. Solid minerals may be either brittle, sectile, malleable, flexible, or elastic. Fluids are either gaseous or liquid.

1. *Brittle*; when on detaching parts of the mineral with a knife, the separated parts fall to a powder. Ex. kerolite, calc spar.

2. *Sectile*; when the detached parts do not fall to a powder. This character is intermediate between brittle and malleable. Ex. gypsum.

3. *Malleable*; when the detached parts separate in slices, or may be flattened out under the hammer. Ex. native gold, native silver.

4. *Flexible*; when the mineral may be bent without breaking, and retains its bent position when the bending force is removed. Ex. talc.

5. *Elastic*; when on removing the bending force, the original position is resumed. Ex. mica.

A liquid is said to be *viscous*, when, on pouring it, the drops lengthen, and appear ropy. Ex. petroleum.

3. FRACTURE.

101. The natural fracture of crystalline minerals has already been noticed under *cleavage*. The fracture of amorphous minerals varies in the form and kind of surface produced.

1. *Conchoidal*; when the minerals break with curved concavities, more or less deep. It is so called from the resemblance of the concavity to the valve of a shell, from concha, *a shell*. Ex. flint.

2 *Even* if the fractured surface is nearly or quite flat

3 *Uneven*, if the broken surface is rough, with numerous small elevations and depressions

4. *Hackly*, when the elevations are sharp or hooked Ex broken iron.

CHAPTER VI

TASTE

102 Taste belongs only to soluble minerals and liquids The different kinds of taste adopted for reference are as follows

1 *Astringent*, the taste of vitriol

2 *Sweetish astringent*, taste of alum

3 *Saline*, taste of common salt

4 *Alkaline*, taste of soda

5. *Cooling* taste of saltpetre

6. *Bitter*, taste of Epsom salts

7 *Sour*, taste of sulphuric acid

This is an important character in distinguishing the soluble minerals.

CHAPTER VII

ODOR

103. Excepting some of the gases and soluble salts, minerals do not in the dry unchanged state give off any odor Odor may be obtained from many, by friction, or by moistening their surfaces with the breath, and also by the elimination of some volatile ingredient by heat or acids The following terms are employed in describing the odors thus obtained from minerals

1 *Alliaceous*, the odor of garlic Friction of arsenical iron elicits this odor, it may also be obtained from any of the arsenical ores or salts, by means of heat

2 *Horse radish odor*, the odor of decaying horse radish This very disagreeable odor is strongly perceived, when the ores of selenium are heated.

3. *Sulphureous*, friction will elicit this odor from pyrites and heat from most of the sulphurets.

4. *Bituminous*, the odor of bitumen.

5 *Fetid*; the odor of sulphuretted hydrogen or rotten eggs It is elicited by friction from some varieties of quartz and limestone

6. *Argillaceous*, the odor of moistened clay It is obtained from serpentine and some allied minerals, after moistening them with the breath, others, as pyrargillite, afford it when heated

PART III.

CHEMICAL PROPERTIES OF MINERALS.

THE chemical properties of minerals are ascertained in two ways; 1, by the action of acids; 2, by heat, concentrated by means of the blowpipe, assisted by various chemical re-agents.

CHAPTER I.

ACTION OF ACIDS.

104. When diluted sulphuric acid, (oil of vitriol,) nitric acid, (aqua fortis,) or muriatic acid, is put on a specimen of calcareous spar, or when this mineral is dropped into either of these acids, there is a rapid escape of bubbles of air, which is termed *effervescence*. In this instance, the air is carbonic acid, which either of the above acids will separate from the lime. Whenever, therefore, a mineral contains a volatile ingredient capable of being expelled by an acid, this character may be employed to distinguish it from others it much resembles in its external characters. In making this trial, it is generally most convenient to apply the acid directly upon the specimen by means of a glass rod. It must be closely observed, that the mineral is quite pure; any fissures or seams are very liable to contain carbonate of lime, or some other substance equally decomposable by acids, which would give a fallacious result. When there is any doubt as to the result obtained, it may be removed by dropping a fragment not larger than a pea, or some of the pulverized mineral, into the acid, and applying heat, if required. A reduction in size or quantity, and the accompanying effervescence, will render manifest the action of the acid. The acids, when employed for this purpose, should be at least one half water. Dilute nitric acid is generally most convenient. In some cases the others are necessary. In these examinations, it is important to observe the odor of the escaping gas; also, whether very suffocating and disagreeable, or merely pungent; also, its color, and if the experiment is performed in a vessel, the color of the solution should be observed.

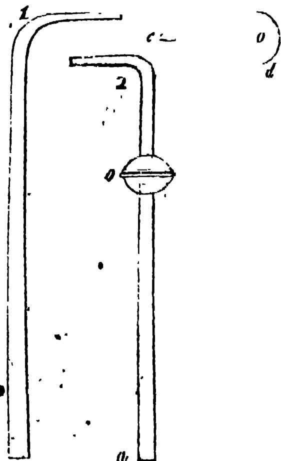
In many instances, solution is obtained without effervescence, and often a mineral is but partly soluble, and the insoluble part is thrown down in the state of a powder; frequently, it may be insoluble in cold, but soluble in hot acid.

Another effect of the action of acids is the formation of a *jelly*. To accomplish this, the finely pulverized mineral is thrown into a *strong* acid, and a gentle heat applied. After a short time, as the solution cools, it gelatinizes. In a few instances, a jelly may be formed with cold acid. By heating the mineral, this property is often destroyed; but occasionally it takes place, with equal facility, before and after heating. These facts will often assist in distinguishing minerals, and should, therefore, be noticed in the descriptions of new species.

CHAPTER II.

ACTION OF THE BLOWPIPE.

105. The first of the annexed figures represents the simplest kind of blowpipe. It is merely a bent, tapering tube of brass, from seven to ten inches long, with a minute aperture at its smaller end. Its use is to concentrate to a point the flame of a candle. This is effected by blowing with the mouth through the instrument, while its smaller end is just within the flame of the lamp or candle.



After blowing awhile, the moisture of the breath often condenses in the tube; and to receive this moisture, and prevent its passing out of the beak, the chamber at *o* (in figures 2 and 3) is usually added. In figure 3, the beak is connected with the barrel or chamber by a universal joint.

When the blowpipe is made of brass, it is usual to have an ivory mouthpiece. Silver is the best material for blowpipes; and the beak should be made of platina, as it may then be cleaned with an acid. Wollaston contrived a convenient pocket instrument on the plan of a common pencil case. The instrument represented in figure 3, has a screw at *c*. On unscrewing it, the part *cd* may be inserted at *a* into the part *ac*, and the two screwed together again. In this way it is as portable as Wollaston's, and has the advantage of being more easily made tight with the screw, and is less liable to get out of order.

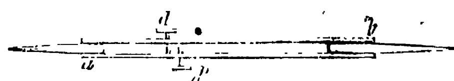
Operations with the blowpipe often require an unintermitted heat for a considerable length of time, and always longer than a single breath of the operator. It is therefore requisite that breathing and blowing should go on together. This may be difficult at first, but the necessary skill or tact is soon acquired. Let the learner attempt first to breathe through his nostrils with his cheeks inflated and mouth closed. This accomplished, if the blowpipe is now put to the mouth, he will find no difficulty in continuing his respirations while the muscles of the inflated cheeks are throwing their contained air through the blowpipe. When the air is nearly exhausted, the mouth may again be filled through the nose without intermitting the process of blowing.

The blowpipe flame consists of two cones; an inner of a blue color, and an outer, yellow. The heat is most intense just beyond the extremity of the blue flame. The inner flame is called the *reduction* flame, and the outer the *oxydation* flame. A mineral reduced to the metallic state by the *inner*, may often be oxydated, or, combined with oxygen, in the *outer* flame, where it is in contact with the atmosphere. For oxydation, the beak of the blowpipe should have a large aperture, and the wick of the lamp should also be large: the heat usually requisite is that of incipient redness.

The best flame is that of a lamp with a large wick, fed by olive oil. When used, the wick should be bent in the direction of the flame. A common candle with a large wick will answer for most of the purposes of the mineralogist.

106. To support the mineral in the flame, either charcoal, or platina forceps or wire, may be used. The charcoal should be well burnt but firm; that from pine wood is the best, as it burns with less ashes. The reaction of the carbon of the coal, aids in reducing or decomposing many mineral species.

A convenient kind of forceps is represented in the annexed figure.



It is made of steel, with platina points (*a*,) pins at *d*, *d'*, for opening the forceps, and a pointed extremity at *b*, for insertion into a handle. The mineral kyanite and also mica is sometimes used for a support when more convenient means are not at hand.

To test the presence of water or a volatile ingredient, the mineral may be supported near one end of a test tube. It may be 3 or 4 inches long and little larger than a quill. The flame is concentrated on the exterior of the tube beneath the assay, and the volatilized substance usually condenses in the upper part of the tube.

107. Many minerals remain unaltered before the blowpipe, unless some substance be added to aid in the fusion or reduction. These substances are called *fluxes:* those in common use are *borax*, *car-*

bonate of soda, and *salt of phosphorus* or *microcosmic salt.** Care should be taken to obtain the fluxes pure, and for this purpose it is well to dissolve or recrystallize the borax; and the soda should be tested for sulphuric acid, as any adulteration with this acid will give the glass obtained with silica, a brown or reddish color. These fluxes should be powdered and added to the mineral, and the whole assay should not exceed the size of a small pea. One fourth this size is better than larger. The soda should be added in small successive doses. This flux is often absorbed by the charcoal; but generally reappears when the heat is sufficiently raised.

Besides the fluxes mentioned, other tests are sometimes used, of which the following are the most important:

Nitrate of cobalt in solution, for distinguishing alumina and magnesia.

Boracic acid and *iron wire*, used in testing for phosphoric acid.

Tin-foil, for fusing with certain peroxyds of metals to reduce them to protoxyds.

Gypsum and *fluor*, used as tests of one another. When two parts of the former and one of the latter are mingled and heated, they fuse to a clear glass. The globule from fluor and heavy spar is subtransparent when cold; and that with sulphate of strontian is more or less frothy.

Saltpetre is employed in discovering manganese when the quantity of this metal is too small to color glass without this reagent. It is added to the heated globule.

108. The effects of the blowpipe are various. Some minerals are volatilized wholly or in part, others fuse at a low temperature; while others melt only on the edges, (then called *subfusible*,) or are wholly infusible. Kobell has proposed the following scale for denoting in figures the degree of fusibility: 1. *Gray antimony.*—2. *Natrolite.*—3. *Cinnamon stone*, (var. of garnet.)—4. *Hornblende.*—5. *Feldspar.*—6. *Chondrodite.* The fusibility, when equal to that of natrolite, is designated by 2; or if like hornblende, by 4, and so on.

The effects of the blowpipe with the fluxes, borax, salt of phosphorus, and soda, on the metallic oxyds and acids, are given in the following table: to a great extent the same effects are obtained with the *salts* of these oxyds. Potash, soda, lithia, magnesia, yttria, glucina, alumina, and columbic acid, are not included. They afford colorless assays, and are not reduced by either of the reagents. The same abbreviations for color and transparency are employed as in the following tables for the determination of minerals. In addition, *Ch.* and *Pl.* are written for the two kinds of supports, *charcoal* and *platina*; also, O. for oxydation flame, and R. for reduction flame.

* This salt, a phosphate of soda and ammonia, may be made by dissolving 16 parts of sal-ammoniac in a small quantity of boiling water, and afterwards adding 100 parts of crystallized phosphate of soda, boiling gently the whole, and then setting it away to cool. The *salt of phosphorus* is deposited in small crystals. If the heat be too great during ebullition, decomposition takes place.

	Borax.	Salt of Phosphorus.	Soda.
Oxyd of tin,	O. colorless. R. colorless.	O. colorless. R. colorless.	*Ch.* reduced with effervescence.
Oxyd of zinc,	O. colorless. R. reduced; white fumes.	O. colorless. R. reduced; white fumes.	Reduced; white fumes on charcoal.
Oxyd of tellurium,	O. colorless. R. partly reduced; gy: op.	O. colorless. R. partly reduced; gy; op.	Colorless, w on cooling; *Ch.* reduced; white fumes & blue flame.
Oxyd of bismuth,	O. colorless. R. colorless.	O. ywh-bn, hot; colorless, cold. R. colorless, hot; gy or bk, cold.	*Ch.* reduced with wh or bnh fumes.
Oxyd of cadmium,	O. a little ywh, at least while hot. R. *Ch.* reduced & vol.	O. *Pl.* infusible. R. *Ch.* reduced & vol.	*Ch.* reduced with bnh-r fumes.
Oxyd of lead,	O. a little ywh, at least while hot. R. partly reduced; gray.	O. yw, hot; colorless, cold. R. yw, hot; colorless, cold.	*Pl.* colorless, hot; ywh and op. cold. *Ch.* reduced with ywh fumes.
Oxyd of silver,	O. milk white. R. partly reduced; gray.	O. ywh or colorless, hot; colorless, cold. R. gray.	
Antimonous acid,	O. ywh, hot; colorless, cold. R. partly reduced; gray.	O. ywh or colorless, hot; colorless, cold. R. colorless, hot.	*Pl.* colorless; *Ch.* reduced with white fumes.
Titanic acid,	O. colorless or milky; milky by flaming. R. ywh, hot; bh-amethyst and trp, cold.	O. colorless, trp. R. ywh, hot; colorless after adding tin.	Deep yw, hot; white or gyh, cold.
Molybdic acid,	O. *Pl.* trp. colorless. R. *Ch.* trp. bnh.	O. gnh, trp, hot; colorless, cold. R. bkh-b, or bk, hot; fine trp. gn, cold.	*Pl.* trp. ywh, hot; w or ywh, cold; reduced on charcoal.
Tungstic acid,	O. trp. colorless. R. ywh, hot; ywh-red, cold.	O. ywh or colorless. R. fine blue; adding iron, blood-red.	*Pl.* trp. ywh, hot; w or ywh, cold; *Ch.* reduced without fumes.
Oxyd of uranium,	O. dull yw. R. greenish.	O. *Pl.* trp. yw; paler on cooling, or pale gnh-yw. R. gn; deeper on cooling.	Ywh-bn; slight indications of fusion.
Oxyd of iron,	O. red, hot; ywh or colorless, cold. R. green or bh-gn.	O. r, hot; paler or colorless, cold. R. greenish.	
Oxyd of nickel,	O. orange or rdh, hot; yw or colorless, cold. R. opaque, gyh.	O. orange or rdh, hot: colorless, cold. R. ditto.	
Oxyd of cerium,	O. r.; yw on cooling; w. enamel on flaming. R. colorless or w. enamel.	O. fine r, hot; colorless, cold. R. trp. colorless, cold.	
Oxyd of manganese,	O. amethystine. R. colorless.	O. amethystine. R. colorless.	*Pl.* trp. gn, hot; bh-gn, cold.
Oxyd of cobalt,	O. trp. blue. R. blue.	O. blue. R. blue.	*Pl.* pale r, hot; gray, cold.
Oxyd of chrome,	O. bn, hot; pale gn, cold. R. emerald-gn, cold.	O. green. R. green.	O. *Pl.* dull orange; op. and yw on cooling.
Oxyd of copper,	O. green. R. colorless, hot; but suddenly op. and rdh on cooling.	O. green. R. colorless, hot; r, on solidifying.	*Pl.* gn, hot; colorless, opaque, cold.

109. *Alumina and magnesia.* If a fragment of alumina, after having been heated to redness, be moistened with nitrate of cobalt and again heated, it assumes a fine blue color. This takes place with most of the infusible compounds of alumina. Magnesia compounds similarly treated, become pale-red, and deepen in color by fusion. This effect is obtained with the silicates of magnesia, except when the metallic oxyds are present.

Potash. The brown glass from borax and oxyd of nickel is rendered blue by potash, an effect not produced with soda.

Lithia. This alkali attacks platina foil and leaves a dull yellow trace. Minerals containing lithia tinge the flame red at the moment of fusion, especially if mixed with fluor.

Sulphurets. A glass made of soda and silica becomes red or orange-yellow when sulphur is present. Sulphurets heated in a glass tube closed below, with litmus paper above, redden the litmus paper.

Selenids. Distinguished by their horse-radish odor, and by a sublimate in the form of a dark red powder, when heated in a glass tube.

Arsenids. Distinguished by an odor like garlic, which may be brought out, if not otherwise perceptible, by heating with soda in the reduction flame.

Chlorids. A dull green pearl made by dissolving a little oxyd of copper in salt of phosphorus, is changed to a fine blue, or purple if a chlorid be added.

Fluorids. When fluorids are heated with salt of phosphorus previously melted in a glass tube, the glass is corroded, and Brazil paper, if placed within the tube, is turned yellow. The salt of phosphorus for this experiment should be free from all chlorids.

Sulphates. Like the sulphurets, in their reaction with a glass of borax and silica.

Nitrates. They detonate on burning coals, and also give off a red gas when heated in a matrass with a drop of sulphuric acid.

Phosphates. If a phosphate be fused with boracic acid, and the extremity of a small iron wire be inserted into the melted globule, and the whole be heated in the reduction flame, the globule formed at the extremity of the wire will prove to be brittle, when struck with a hammer on an anvil. Before this trial it should be ascertained that no sulphuric or arsenic acid is present, which also may form a globule with the iron; nor any metallic oxyd reducible by the iron.

Silicates. The silicates are decomposed by salt of phosphorus and silica set at liberty. When but little of the flux is used, the silica generally absorbs the liquid mass; but by adding more of the flux the silica is suspended in the liquid globule, which becomes subtransparent. The assay with most silicates is transparent when hot, and opaline on cooling. *Columbic acid* differs from silica in forming a clear glass with salt of phosphorus.

Borates. When a borate is melted with Turner's reagent, (a mixture of two parts of fluor and one of bisulphate of potash,) the flame is brightly tinged with green.

These few facts with regard to the action of the metallic oxyds and acids and many salts before the blowpipe will be found highly useful to the mineralogist. For a more complete account of the blowpipe and of its use in chemical analysis, I would refer to the Treatise by Berzelius,* or Plattner,† Valerius's French edition of Berzelius, or a late work on Chemical Manipulation, by J. J. Griffin.‡

In addition to the instruments already described, the following are important: 1. A *small hammer* with a slightly rounded face and a transverse sharp edge at the other extremity. 2. *An anvil* or piece of steel 3 inches long, 1 broad, and $\frac{3}{16}$ thick—to be used for pulverizing minerals, for which purpose the specimen should be first wrapped in a piece of paper. 3. *Platina foil,* for enveloping minerals that decrepitate. 4. *Cutting pliers,* for separating small fragments of a mineral for assay.

* The German edition—Die Anwendung des Löthrohrs in der Chemie und Mineralogie, 3d ed. Nuremberg, 1837.

† Die Probirkunst mit dem Löthrohre. Leipzig, 1835. By Carl Friederich Plattner.

‡ On Chemical Manipulation and the use of the Blowpipe. 1 vol. small 8vo. Glasgow, 1837.

PART IV.

TAXONOMY.

TAXONOMY is that branch of Science which investigates the principles of System It embraces the two dependent subjects, Classification and Nomenclature

CHAPTER I.

CLASSIFICATION

MINERALOGICAL SPECIES.

110. It has already been remarked, that the power of crystallization in the mineral kingdom is analogous to that of vitality in the other kingdoms of nature As in these kingdoms, therefore the existence of species and their peculiarities depend on the action of this vitality, so in the mineral kingdom, the existence of mineralogical species and their forms, arise from the power of crystallization. It must be understood that the term crystallization as here used, includes not merely the action of the attraction that aggregates the molecules in the formation of a crystal, but also the power that gives the *molecule* its crystalline form and attractions.

Regularly crystallized minerals alone, therefore, are properly *perfect* individuals in the mineral kingdom; imperfect crystallizations, like the monsters among organic bodies, have arisen from a suspension of the regular laws of nature by some extraneous influence. It would, hence, be theoretically correct, and in accordance with the practice in the Botanical and Zoological Sciences, to confine the term species to perfectly crystallized individuals, and in the descriptions, to give their characters alone, reserving for subsequent remark, the imperfect crystallizations or mineral monsters But inorganic nature differs from organic, in this essential particular, that while in the latter, exceptions to this regular action of vitality are but seldom observed, in the former, they are far the most numerous, perfect individuals being of comparatively rare occurrence. And although it may be highly desirable that the general laws at

the foundation of classification in the three kingdoms of nature should be uniformly observed, it must be admitted that it is impracticable in the science of which we are treating.

111. The following is a definition of a mineral species:

A mineral species is a natural inorganic substance, composed of particles capable, in favorable circumstances, of combining by means of their mutual attractions, so as to constitute a crystalline solid.

We thus include among the mineral species, the liquids and gases found in nature, for they require only a proper temperature, or favorable circumstances of pressure, and a freedom from disturbing causes, to enable them to assume a regular crystalline form. We also include all natural inorganic products, in which a tendency to crystallization can be detected, although they have never been observed in regular crystals. We exclude all mechanical aggregates, which, as they are composed of heterogeneous particles, can never assume, from any innate powers, the forms of a crystalline solid.

This definition implies that the substance is a definite chemical compound, as such only are of homogeneous composition. But chemical analysis is not therefore always an available test of the homogeneity of a crystal; crystallization is quite as generally important, as a test of chemical combination, and is often referred to for this purpose.

IDENTITY AND NON-IDENTITY OF SPECIES.

112. Abstractly considered, those individuals are conspecific that possess all the essential qualities to a mineral species. It is therefore important to understand the relative value of crystallographic, physical, and chemical characters, in the determination of identity.

a. Importance of Crystallization in determining Identity.

The characters of minerals depending on crystallization when they can be observed, are entitled to the first consideration in determining the identity of species. The presence of accidental ingredients or impurities may change entirely many of the physical properties of minerals, as their color, transparency, hardness, &c. and may alter their chemical composition. The same causes leave untouched, with few exceptions, the angles of crystals and their cleavage characters. The following is therefore a fundamental canon in the science, and should take precedence of all others in the institution of species.

Similarity of crystallization may indicate an identity of species; dissimilarity of crystallization proves a non-identity.

The principles of Isomorphism have greatly enhanced the importance of this canon, establishing the fact that compounds differing in constitution may be physically identical.

b. Importance of Physical Characters in determining Identity.

113. In the above canon it is stated that a similarity of crystallization *may indicate* an identity of species; it is not always sufficient to *establish* an identity especially in the tesseral system, in which the relative dimensions and angles are constant. In these instances, and also for imperfectly crystallized specimens, physical characters must be referred to.

Physical characters differ much in the degree of importance that should be attached to them. They all vary more or less in some of the mineral species; but as the limits of variation, with several of these characters, are in most instances but small, by possessing a knowledge of these limits, we may often confidently determine with respect to the identity of species.

These characters should receive the attention of the mineralogist, in the following order:

1. *Lustre.* The distinction of *metallic* lustre from *non-metallic*, is of the first importance. Excepting this, *lustre* should rank low among the physical characters; for the line of demarcation between the kinds of non-metallic lustre is very indistinct, and often all are presented by the same species.

2. *Streak.* Streak, or the color of the powder, is a highly important character, as it seldom varies with the color of the mineral.

3. *Hardness.* The liability of some minerals to decomposition, their accidental impurities, and the various mechanical states they may present, render this in some instances a character of some little uncertainty. It is, however, easily determined, and if the limits of variation are known, it may subserve an important purpose in the determination of species. An allowance of 0.5 at least, should usually be made for variation.

4. *Specific Gravity.* This character is subject to some variation, for the same reason as that of hardness, and also on account of the variations in composition arising from impurities and the substitution of isomorphous substances in the composition of species.

5. *Color.* Color is usually a very inconstant character. It is, however, subject to but little variation in those species that have a metallic lustre, and it is therefore highly valuable in distinguishing these species. It is not without some value in the analyses of the non-metallic minerals.

6. *Diaphaneity.* The remarks on color also apply to the characters depending on diaphaneity.

7. *State of Aggregation.* This character is also more especially useful among the metallic minerals, but occasionally affords assistance in examinations of the non-metallic species.

8. *Taste.* Taste can be employed only among the few soluble minerals. With these it is highly important.

9. *Fracture.* This character is seldom of much value. It may be employed in distinguishing varieties rather than species.

10. *Refraction*, *Phosphorescence*, *Electricity*, *Magnetism*, and *Odor*, are each of very limited importance.

c. Importance of Chemical Characters in determining Identity.

114. The variations among imperfectly crystallized minerals are often so great, and consequently the differences between the varieties of different species are frequently so slight, that physical characters often prove inadequate for the distinction of species. In these instances, which are quite numerous, blowpipe and chemical tests will be found valuable aids. Chemical analysis is not usually within the reach of the mineralogist. Its results are important, though liable to error, from the impurities often mechanically mingled in opaque crystals or amorphous minerals.

CLASSIFICATION OF MINERALS.

115. The arrangement of objects according to any assumed system, is styled a classification. By using different classes of characters to mark the grand divisions, various modes of arrangement may be made out. Of these there is one *natural* system; the rest are *artificial* classifications.

Artificial classifications may sometimes be used to advantage for the convenience of comparison in identifying species; but farther than this, they only lead to error, by suggesting false affinities and unnatural associations of species. An arrangement of this kind is adopted in this treatise, founded on the crystalline forms. Excepting the purpose for which it is instituted—the determination of the names of minerals—it subserves no important end to the mineralogist; on the contrary, it brings together species the most unlike, and separates those most closely allied.

The natural system is a transcript of nature, and consists of those family groupings into which the species naturally fall. In making out such a classification, instead of conforming the whole to certain assumed principles, the various affinities of the species are first ascertained, by studying out all their peculiarities and resemblances, and from these the principles of the system are deduced. There should be no forced unions to suit preconceived ideas, but only such associations as nature herself suggests.

Unlike the other branches of natural science, mineralogy admits also of a *chemical* classification, or one founded on the chemical constitution of the species; and as minerals proceed from chemical instead of vital action, there is some reason for the adoption of chemical characters into the natural system. When the chemical relations of the elements are well understood, it is not too much to assert, that the *chemical* and *natural* systems will be identical.

In the received chemical systems, analogies and affinities are very generally violated. Some authors arrange minerals according to the electro-positive element (the base) in their composition; and others

follow the electro-negative element, (the acid:) and in both cases numerous difficulties obtain. The true system should conform to the one or the other, according to which is the characterizing ingredient; and on this plan, keeping in view also the principles of isomorphism, the chemical classification would not differ from the natural system.

Carbonate of lime, carbonate of magnesia, carbonate of iron, and carbonate of manganese, are allied chemically—for their bases, lime, magnesia, oxyd of iron, and manganese, are isomorphous—and in physical and crystallographic characters they are also very similar. The group is therefore a natural one. The sulphates of several of the metals constitute a family of vitriols which are always associated in common language, and with equal propriety, in science. But most chemical arrangements break up these natural groups, and place sulphate of iron (green vitriol) and carbonate of iron together under iron, sulphate of copper (blue vitriol) under copper, and so on. There is a natural group of alums, a potash-alum, soda-alum, magnesia-alum, &c., which is almost invariably broken up in the chemical systems, one placed with the salts of potash, another with the salts of soda, &c. A single species in mineralogy, pyroxene, is sometimes subdivided and distributed in distant parts of the system, This species includes several distinct chemical compounds, as will be seen by referring to *Pyroxene*, in the descriptive part of the treatise; but they are so closely related physically, and, if we consider the isomorphism of the bases, we may say chemically also, that many *chemists* rank them in the same family. The micas evidently form a natural group, yet a chemist separates the rose mica from the others, and places it with other lithia minerals, because it contains a few per cent. of lithia. The natural family of the feldspars and the zeolites, are usually broken up in the same manner. A few per cent. of the base will often lead to a dissevering of the closest affinities. The sulphurets of iron, copper, &c. form evidently a natural group chemically as well as mineralogically, yet without reference to their relations, they are usually distributed under the different metals, although sulphur is here the characterizing ingredient. All the compounds of the metals are generally thrown together; whereas even chemistry, if its principles were well considered, would suggest that the salts of the various metals are in general more nearly allied than the salts and oxyds of the same metal. There can be no more unnatural association of species than the sulphate of iron, (green vitriol,) carbonate of iron, phosphate of iron, and specular iron. Titanate of iron and specular iron are isomorphous and similar physically, yet chemical systems would separate the two, and place the former along side of other salts of iron.

Besides, various chemical compounds pass into one another by the gradual substitution of one isomorphous base for another, and although the extremes might be easily arranged in a chemical sys-

tem, yet the transitions are disposed of with much difficulty. The augite family is a striking example.

A true chemical system should take into consideration the isomorphous relations of the elements or bases, and not be subservient to any one set of characters. That element in the compound should be assumed for the ground of distinction, which fixes the peculiar features of the species—the acid in some species, the bases in others. In the vitriols, the acid (sulphuric) is the characterizing ingredient; in the alums, sulphuric acid and alumina; and so on. No chemical system can satisfy the demands of the science which does not follow nature's own windings. We would not say that the system of Mohs, adopted in this treatise as the natural system, is perfect; yet whether we consider it chemically or mineralogically, it will be found to approach more nearly to such a system than any other that has been proposed.

Theory of Artificial Classifications.

116. Were all minerals invariably crystallized, a single classification according to the different classes of crystalline forms, would be the most convenient, in all instances, for determining the names of species. But, unfortunately for system, irregular crystallizations are by far the most common. We therefore propose two systems of artificial classification, the one, *depending on crystallization*, the other, *independent of the same;* the former to contain only those minerals which are sometimes in the crystalline state, the latter, all the mineral species. The former will be found most convenient when the specimen under examination is in regular crystals.

The classes which readily present themselves for an artificial classification, depending on the crystalline forms, have already been given in § 9, and the means of determining the system of crystallization from secondary planes in § 52. We may often arrive at the system of crystallization with facility, when the particular primary cannot be determined. A mineral of the Trimetric system might be ascertained to belong to this system, while it was impossible to distinguish whether its primary were a right rhombic prism, right rectangular prism, or a right rhombic octahedron. This classification is, therefore, preferable to one in which each primary forms a separate class.

The classes in this system of classification, are

1. Monometrica.	4. Monoclinata.
2. Dimetrica.	5. Triclinata.
3. Trimetrica.	6. Hexagona.

It is unnecessary to repeat an enumeration of the primaries included in these classes; they are given in § 9.

Each of these classes may be subdivided into the orders, unmetallic and metallic. The former includes minerals *without*, the

latter *with* metallic lustre. A few species have a submetallic lustre; to avoid all difficulties, these may be enumerated in each order. All the purposes of analysis may be secured, without a distribution of the species into smaller divisions, or genera.

117. In the construction of an artificial classification, *independent of crystallization*, the three classes adopted are a natural distribution of the species. They are as follow:—

Class I.

Includes the gases, unmetallic liquids, and soluble minerals, or minerals possessing taste. Their specific gravtiy is below 3·8.

Class II.

Includes insoluble minerals not of vegetable origin. Sp. gr. above 1·8.

Class III.

Includes species derived from the alteration or decomposition of vegetable, or animal matter. Sp. gr. under 1·8.

The species of the first class may be distributed into two divisions; the *first*, to include the fluid species, and the *second*, the solid. The second division may be farther subdivided, according to the taste of the species and the degree of solubility.

Class II.	1 Lustre unmetallic.	*a.* Streak white or grayish-white.
		b. Streak colored.
	2. Lustre metallic.	

According to this table, the species of the second class are first divided into two sections; 1, those with unmetallic lustre, and 2, those with metallic lustre. Those with unmetallic lustre are farther subdivided according to their streak.

Those few minerals whose streak varies, or is of doubtful character, are introduced into both the divisions, in the same manner as those of doubtful or varying lustre. Thus all difficulties may be avoided arising from incorrect decisions in these doubtful cases.

The third class contains but few species, and requires no subdivisions.

Theory of the Natural Classification.

118. The system of Mohs is, in the main, here adopted. The following are its general subdivisions:

Class I.

G. under 3·8. Fluid or soluble. No bituminous odor. Taste of solid individuals, acid, alkaline, or saline.

CLASS II.

G. above 1·8. Insoluble.

CLASS III.

G. under 1·8. Resinous or carbonaceous. Combustible.

CLASS I.

Order 1. RHEUTINEA,* (ῥευτος, *fluid.*)

Gaseous or liquid.

Order 2. STERINEA, (στερεος, *solid.*)

Individuals solid.

CLASS II.

Order 1. HALINEA, (ἅλινος, *saline.*)

H.=1—5·5. G.=1·8—3·3. Lustre unmetallic. Streak uncolored.

Order 2. BARYTINEA, (βαρυτης, *weight.*)

H.=2—6. G.=3—8·1. Lustre unmetallic.

Order 3. CERATINEA, (κέρας, *horn.*)†

H=1—2. G.=5·5—6·5. Lustre resinous, passing into adamantine.

Order 4. OSMERINEA, (ὀσμηρος, *odorous.*)

H.=1·5—3. G.=2—3·1. Odor, when moistened, argillaceous. Lustre unmetallic. Streak uncolored.

Order 5. CHALICINEA, (χάλιξ, *silex.*)‡

H.=2—7. G.=2·6—4. Lustre unmetallic. Streak uncolored.

Order 6. HYALINEA, (ὑαλινος, *glassy.*)§

H.=6—10. G.=2·6—4·8. Lustre unmetallic. Streak uncolored.

---

* The nomenclature here adopted, will be more fully explained in a future section. The orders employed by Mohs, as translated and adopted by Haidinger and Allan, are as follow:

Class I.—Order 1. *Gas.* 2. *Water.* 3. *Acid.* 4. *Salt.*

Class II.—Order 1. *Haloide.* 2. *Baryte.* 3. *Kerate.* 4. *Terene.** 5. *Malachite.** 6. *Mica.** 7. *Steatite.** 8. *Spar.* 9. *Gem.* 10. *Ore.* 11. *Metal.* 12. *Pyrites.* 13. *Glance.* 14. *Blende.* 15. *Sulphur.*

Class III.—Order 1. *Resin.* 2. *Coal.*

The order ACID, in Class I., contains both gases, liquids, and solids, and, moreover, the individuals are not uniform in presenting a sour taste. It appeared preferable to be guided by the more important natural characteristic, the mechanical state of fluidity or solidity, and consequently, instead of the four orders of Mohs in this class, I have adopted the two, RHEUTINEA and STERINEA.

The species of those orders in Class II., marked with an asterisk, have been omitted in the classification adopted. The characteristics of these orders are not of sufficient importance to require the separation of the species they include from their natural congeners in other orders. By this change, a few exceptions to the distinctions of orders and genera have been introduced. Exceptions of this kind have been found unavoidable in other branches of natural history, and are less objectionable than discrepancies in the *natural* character of the classification.

† In allusion to the horn-like lustre of the species.

‡ The species, in general, contain silica.

§ In allusion to the high degrees of lustre.

Order 7. SCAPTINEA, (σκάπτος, *that which is dug.*)

H.=1—7. G.=2—8. Color dark red—black. Streak colored, unmetallic.

Order 8. METALLINEA, (μεταλλον, *metal.*)

H.=0—5. G.=5·7—20. Lustre and streak metallic. Color white, gray, yellow, or slightly reddish.

Order 9. PYRITINEA, (πυρίτης, *pyrites.*)

H.=3—6·5. G.=4·6—9·4. Lustre metallic. Streak unmetallic. Color white, yellowish or reddish. Brittle.

Order 10. GALINEA, (γελεω, *to shine.*)

H.=1—4. G.=4·2—8·5. Lustre metallic. Streak unmetallic. Color dark gray or black. Brittle.

Order 11. ADELINEA, (ἄδηλος, *unmanifest.*)*

H.=1—4. G.=3·3—5·9. Lustre submetallic or unmetallic. Streak colored, unmetallic.

Order 12. THEIINEA, (θεῖον, *sulphur.*)

H.=1·5—2·5. G.=2—2·1. Lustre unmetallic. Color yellow. Streak colored.

CLASS III.

Order 1. PITTINEA, (πιττα, *pitch.*)

Easily fusible.

Order 2. ANTHRACINEA, (ἄνθραξ, *coal.*)

Infusible.

119. In the above system, the *first* class includes the fluid and soluble minerals; the *second*, the insoluble, earthy, and metallic species; the *third*, coals and resins, resulting from the alteration of vegetable or animal matters.

The second class, which contains the greater part of the mineral species, commences with the saline earthy minerals, which follow naturally the soluble salts in Class First. From these, there is a gradual transition through the earthy minerals to the gems, and thence, through the metallic oxyds to the metals and metallic sulphurets. Chemically considered, it will be observed that the first three orders include, in general, the species which consist of a base with the soluble acids—in other words, the salts of the metals; for lime and magnesia are metallic oxyds as much as the oxyds of iron, copper, &c. The next three orders contain the silicates and aluminates, commencing with the softer species, and ending with the gems. Then follow the metallic oxyds, commencing with the unmetallic, which unite them with the gems, and ending with the metallic species. Some metallic silicates, and salts with the metallic acids, titanic acid, columbic acid, &c., fall into this order. The following order comprises the native metals. The next three contain the sulphurets, selenids, and tellurids of the metals. These

* The metallic nature of the species is disguised by the mineralizing ingredie

end with the species of the blende family, which have an imperfectly metallic lustre, and form a natural transition to sulphur, and thence to Class Third, or the coals and resins.

120. In laying down the distinctions or limits of genera, far greater difficulties must be allowed to exist than in the organic kingdoms; yet there are certain relations or affinities which may be employed, although we have not the important characters arising from organization. These relations have been very happily distinguished and employed by Mohs. The striking beauties of the system will forcibly impress the minds of those who may give it the attention it merits. The distinctive characteristics expressed, may not exhibit fully the peculiarities which separate two genera, but a slight examination of a few of the species is sufficient to convey a distinct impression of the generic peculiarities. For example; it requires but a passing glance to observe that the genus, including the closely allied species, *feldspar*, *albite*, *Labradorite*, &c., is very evidently distinct from the following one, including *pyroxene*, *hornblende*, &c. The broad tabular crystallizations of the former are quite unlike the slender forms of the latter. Yet occasionally, hornblende may assume a short, flattened appearance, and feldspar may lengthen itself into slender prismatic crystals. Thus, by the great variations to which the mineral species are subject, it is difficult clearly to characterize genera. This classification is well fitted to exhibit a correct transcript of the affinities of the species, and thus to assist in imparting a particular acquaintance with their mutual relations, their resemblances, and peculiar characteristics, and convey a general and systematic view of the science.

For the purpose of mineralogical analysis, the *artificial* classifications, given in the following sections, will be found convenient and fully sufficient.

CHAPTER II.

NOMENCLATURE.

121. A system of nomenclature is a method of naming a class of objects, according to certain assumed principles. Of such a system the science of mineralogy, as generally received, is destitute. The names in use, except those by Mohs, are arbitrary, and consequently possess no advantages, except merely as appellations for the species. It has usually been sufficient to add the termination *ite* or *lite*, (originally from λιθος, *a stone*,) to the name of some person or locality, and rarely to some quality of the mineral, and thus to denote the species. Occasionally German words have been thus transformed, and introduced into our English treatises on mineralogy; and words of various languages have been forced into unnatural

union. At present, therefore, mineralogical nomenclature is devoid of all system, and is destitute of those advantages that characterize the botanical and zoological nomenclatures. Linnæus and Werner attempted a renovation of mineralogical nomenclature, in conformity with the systems in the other branches of science. But owing to the unadvanced state of the science, their proposed nomenclatures, though adopted for a time, soon proved inadequate. A system by Mohs, the distinguished author of the natural classification which has been adopted, has been for some time before the world. Translated from the German, in which it was published by its author, into our own less pliant language, it loses many of its advantages, and is very much wanting in conciseness and elegance of expression.

The only language fitted for a system of nomenclature, both as regards conciseness and pliability, is the Latin language. In proposing, therefore, a system of nomenclature, this language has been employed. For the acquisition of scientific information, and a systematic idea of the science, a nomenclature similar to that which will be employed, is highly important. The shorter trivial names should however be retained, as more convenient for common use.*

Names of genera and species. A *genus* being a family, including one or more *species*, the name of the genus should be a substantive, and that of the species an adjective—rarely a substantive—prefixed to, and qualifying, the generic name. The specific name should express some quality or important fact relative to the species, so that the combined name shall bring before the mind an idea of the species represented. For example; in naming a family composed of species having a glassy lustre, we first select a substantive, conveying this general idea, as the word *Hyalus* in this instance, derived from ὕαλος, *glass*. In naming the species *Iolite*, which belongs to this genus, an obvious quality is its dichroism; this affords the combined name *Hyalus bicolor*. In a similar manner, the systematic denomination of other species may be formed. Chemical, physical, and crystallographic characters may each afford the names of species. Only those physical qualities should be selected which are constantly presented by the species in all, or, at least, the greater part of its varieties. The primary form of the species has been designated in the specific name by the following terms:

Cubicus,	primary form,	the cube.
Octahedrus,		the regular octahedron.
Pyramidalis,		square octahedron.
Dodecahedrus,		the dodecahedron.
Quadratus,		a right square prism.
Rectangulus		a right rectangular prism.
Rhombicus,		a right rhombic prism.

* On account of the very general use of the present nomenclature of this science, the systematic names which will be proposed, will be merely appended in the descriptive part of this treatise, to the common name

Rhomboideus, primary form, a right rhomboidal prism.
Obliquus, " " an oblique prism, (restricted to the oblique rhombic.)
Triclinatus, " " the oblique rhomboidal prism.
Rhombohedrus, " " rhombohedron.
Hexagonus, " " hexagonal prism.

The terms *monometricus, dimetricus,* &c., expressing the crystallographic system of the primary, may also be employed. The term *monoclinatus,* when used, refers to the *oblique rhombic prism;* the other prism in this class, the *right rhomboidal,* will be specified as stated above. The term *prismaticus* may be applied to any prismatic crystal; it has been restricted, however, to the forms in Mohs's Prismatic System of Crystallization, the Trimetric class in the system adopted.

The several varieties of cleavage may be expressed as follows:

Peritomus, (περι, *about,* and τέμνω, *to cleave.*) Cleavage parallel to the lateral faces.
Acrotomus, (ἄκρον, *summit,* and τέμνω.) Cleavage parallel to the basal plane.
Diatomus, (δια, *through,* and τέμνω.) Cleavage parallel to a diagonal plane.
Eutomus, (εὖ, *easily,* and τέμνω.) Cleavage easily effected.
Dystomus; (δυς, *difficulty,* and τέμνω.) Cleavage obtained with difficulty.

The remaining terms employed, and their explanations, are given in connection with the full exposition of the classification preceding the descriptive part of this treatise.

In the selection of generic terms, significant names are to be preferred, and, if possible, they should express the family peculiarity which requires the union of the species in the genus, or some quality which they have in common. Occasionally this may be difficult or impossible, in which case a name may be adopted, which, by its frequent use as the denomination of a mineral, or other object, will carry with it a general impression of the character of the genus.

Words derived from names of persons distinguished for their mineralogical attainments, or their patronage of the science, may be properly employed to designate species. But the use of other names, though of persons eminent in the other sciences, is wholly at variance with good usage and propriety. Moreover an attempted flattery of the politically distinguished is degrading to science, and cannot be too strongly discountenanced.*

The masculine gender has in general been employed, excepting in the first class containing the soluble species, and in the order metallinea, whose ancient names are principally of the neuter gender. A uniformity of termination has been adopted in the generic names in some of the orders, viz., the orders Halinea, Barytinea, Pyritinea, and Galinea, in order to exhibit, as far as possible, the general relations of the species.

* For more particular rules on the formation of systematic names, and the correct method of writing them, we would refer to LINNÆI *Philosophia Botanica;* ed. tertia aucta et emendata curâ C. L. Willdenow, 8vo. Berolini, 1790; also *Elementa Philosophiæ Botanicæ,* auctore HENR. FRID. LINK, 8vo. Berolini, 1824; and DECANDOLLE and SPRENGEL'S *Philosophy of Plants,* 8vo. Edinburgh, 1821.

PART V.

DETERMINATIVE MINERALOGY.

CLASSIFICATION I, DEPENDING ON CRYSTALLIZATION.

A GENERAL explanation has already been given of the systems of artificial classification, which we propose to adopt in order to facilitate the determination of species. In the system dependent on crystallization, the classes are subdivided according to the lustre of the species, into sections, *unmetallic* and *metallic*. A few species of intermediate lustre are thrown into each section.

A tabular arrangement has been adopted, as one best suited for reference; and the order in which the characters are employed is that of their relative importance, as given in § 113. The species are arranged according to their hardness, as no character is determined with more facility, or is more generally available; for, unlike the character of specific gravity, it matters not whether the specimen be imbedded or not, in large or in small masses.

The number of characters employed in this classification is less than in the following system, independent of crystallization, since a less number of characters is requisite when the mineral is in perfect crystals. In the second artificial classification, every character has been introduced which could afford assistance in attaining the end for which it was constructed. The degree of fusibility has, in most instances, been stated in numbers, according to the scale introduced by Von Kobell, (§ 108.) For the convenience of reference to the full descriptions of the species, the page on which they may be found, is given after the name of each species.* To aid in following the descriptions across the two pages, in the Tables, the lines are numbered alike on each.

---

*An explanation of the abbreviations employed in the following pages, and of the manner of using the arrangement for mineralogical analysis, is given at the close of the two artificial classifications.

CLASS I. MONOMETRICA.

SECTION I. LUSTRE UNMETALLIC.

	Names of Species.		*Hardness.*	*Sp. Gravity.*	*Cleavage.*
1	Horn Silver, 299.	*Prim.*	1—1·5.	5·5—5·6.	None; cubc.
2	Bromic Silver, 300.		1—1·5.		
3	*Arsenous Acid, 214.		1·5.	3·6—3·7.	
4	*Sal Ammoniac, 222.	*Volc. &c.*	1·5—2.	1·528.	Octahedral.
5	Common Salt, 219.		2	2·257.	Cubic.
6	Potash Alum, 216.		2—2·5.	1·7—1·8.	Oct.
7	Cube Ore, 268.		2—3.	2·257.	Imp. cub.
8	Blende, 503.		3·5—4.	4—4·2.	Dodec. perf.
9	Red Copper Ore, 125.		"	5·8—6·1.	Oct. imp.
10	*Bismuth Blende, 283.	*Prim.*	3·5—4·5.	5·9—6·1.	Dodec.
11	Fluor Spar, 236.		4.	3—33.	Oct. perf!
12	Pyrochlore, 434.	*Prim.*	5—5·5.	3·8—4·5.	None.
13	Analcime, 337.	*Amyg. Volc.*	"	2—2·3.	Imp.
14	*Periclase, 405.	*Vesuv. Dolomite.*	5·5.	3·75.	Cubic.
15	*Perovskite, 424.	*Prim.*	"	4·01—4·1.	Cubic.
16	Chromic Iron, 445.	*Serpentine.*	"	4·3—4·5.	Oct. imp.
17	*Lapis Lazuli, 339.		5·5—6.	2·5—2·9.	Imp.
18	Sodalite, 338.	*Volc. &c.*	"	2·25—2·4.	Dodec. imp.
19	Leucite, 338.	*Volc.*	"	2·45—2·5.	Cub. ind.
20	*Hauyne, 339.	*Volc.*	6.	2·7—3·3.	Imp.
21	Helvin, 385.	*Prim.*	6—6·5.	3·1—3·3.	Oct. in traces.
22	Garnet, 382.	*Prim. Volc.*	6·5—7·5.	3·5—4·3.	Dodec. imp.
23	*Boracite, 405.	*Gypsum.*	7.	2·974.	Oct. ind.
24	*Rhodizite, 406.	*Prim.*	above 6.		
25	Automolite, 397.	*Prim.*	7·5—8.	4·2—4·4.	Oct. perf.
26	Dysluite, 397.	*Prim.*	"	4·5—4·6.	Oct. imp.
27	Spinel, 395.	*Prim.*	8.	3·5—3·6.	Oct. ind.
28	Diamond, 399.		10.		Oct. perf.

SECTION II. LUSTRE METALLIC.

1	*Vitreous Silver, 488.	*Prim.*	2—2·5.	7·15—7·4.	Dodec. imp.
2	Native Bismuth, 463.	*Prim.*	"	9·7—9·8.	Oct. perf!
3	*Native Amalgam, 463.	*Ores. merc.*	2—3·5.	10·5—14.	Dodec. imp.
4	Selenid of Mercury and Lead, 499.			7·3.	Cubic.
5	*Selensilver, 487.		2·5.	8.	Cubic perf.
6	Variegated Copper Ore, 480.		2·5—3.	5—5·1.	Oct. imp.
7	Galena, 496.		"	7·5—7·7.	Cub. em.
8	Native Copper, 464.		"	8·4—8·8.	None.
9	Native Silver, 461.		"	10·3—10·5.	None.
10	Native Gold, 460.		"	12—20.	None.
11	Gray Copper Ore, 483.		3—4.	4·7—5·2.	Ind.
12	*Manganblende, 503.		3·5—4.	3·9—4·1.	Cub. perf.
13	Blende, 503.		"	4—4·2.	Dodec. perf.
14	*Tennantite, 485.		"	4·3—4·5.	Dodec. imp.
15	*Tin Pyrites, 483.	*Prim.*	4.	4·3—4·4.	
16	Platinum, 458.		4—4·5.	16—19.	Cubic, ind.
17	*Bismuth Nickel, 472.		4·5.	5·1—5·2.	Oct.
18	Iron, 457.		"	7·3—7·0.	Oct.
19	*Nickel Stibine, 469.		5—5·5.	6·4—6·5.	Cub. imp.
20	Chromic Iron, 445.	*Serpentine.*	"	4·3—4·5.	Oct. imp.
21	Nickel Glance, 471.		"	6·05—6·2.	Cub. em.

CLASS I. MONOMETRICA.

SECTION I. LUSTRE UNMETALLIC

	Lustre	Color Diaphaneity &c
1	Res ad	C gy; bh, gnh, bnh St sh Trl—subtrl Malleable and sectile
2	Res	C gn, yw
3	Vit—Silky	C w, ywh, rdh St w Trp—op T astringent, sweetish Sectil usually in stell cryst, or bot
4	Vit	C w, ywh, gyh; Trl—op T pungent and saline
5	Vit	T purely saline
6	Vit	C w Trl T sweetish astringent and acid, like common alum
7	Subad	C gn, ywh, bkh, bn St pale olive gn—bn Trl—op
8	Ad—res	C bn, bk, yw, rd, gn St w—rdh-bn Trp—op
9	Ad	C cochineal and carmine rd; St bnh rd Sbtrp—sbtrl
10	Res	C bn, ywh-gy, straw yw St ywh-gy Sbtrp—op
11	Vit	C various, mostly bright Trp—sbtrl Phosphorescent when heated
12	Res vit	C dark rdh bn, wax-yw St pale bn, or ywh Sbtrl—op Octahedral
13	Vit	C w, gyh, flesh red St w Trp—op Cubic and trapezohedral
14	Vit	C gnh Trl crystals small
15	Met ad	C gyh to iron-bk St gyh w Opaque
16	Submet	C between iron-bk and bnh-bk St bn Op
17	Vit	C rich blue Trl—op
18	Vit	C bn, gn, gy, b St w, or bh Trl—op Gelatinit
19	Vit	C w, gyh w St w Trl—op Trapezohedral
20	Vit	C bright blue, asparagus gn Trp
21	Vit, res	C wax yw, ywh bn, gn St w Tetrahedral
22	Vit, res	C rd, bn, bk, w, yw, gn St w, gyh-w Trp—op
23	Vit ad	C w, gyh, ywh, gnh St w Cubic, hemihedral
24	Vit ad	C gyh or ywh-w Trl Resembles boracite
25	Vit res	C dirty gn, bk St w Sbtrl—op In octahedrons
26	Vit res	C ywh-bn, gyh bn St paler Subtrl—op In octahedrons
27	Vit	C rd, b, gn, yw, bn, bk St w Trp—op Octahedral
28	Ad	C various

SECTION II. LUSTRE METALLIC

1	Met	C and St bkh-lead-gy, St shining
2	Met	C and St silver-w, rdh, subject to tarnish Sectile
3	Met	C and St silver-w Brittle
4		C lead-gy; bh and iron-bk
5	Met	C and St iron-black
6	Met	C bnh and rdh-yw; tarnish bh, rdh St pale gyh-bk: Brittle
7	Met	C and St lead-gy; tarnish gyh-bk Rather sectile
8	Met	C and St rdh; Ductile and malleable
9	Met	C w, tarnish gyh-bk Ductile
10	Met	C gold-yw Very ductile and malleable
11	Met	C and St steel-gy, iron-bk St like color, or bnh. Tetrahedral
12	Submet	C iron-bk bn on exposure St gn Rather sectile
13	Submet, ad, res	C bn, yw, bk, rd, gn St w—rdh-bn Trp—subtrl
14	Met	C bkh-lead-gy St rdh-gy Brittle
15	Met	C steel-gy; ywh St bk Brittle
16	Met	C and St light steel-gy Ductile
17	Met	C light steel-gy to silver-w; ywh, gyh tarnish Brittle
18	Met	C and St iron-gy St shining; Ductile Acts on the magnetic need
19	Met	C steel-gy silver-w Brittle
20	Submet	C between iron-bk and bnh-bk: St bn Brittle
21	Met	C silver-w—steel-gy St gyh bk

Names of Species.	Hardness.	Sp. Gravity.	Cleavage.
1 Cobaltine, 473. *Prim*	5—5·5.	6·1—6·3.	Cub. perf.
2 *Cobalt Pyrites, 474. *Prim.*	"	6·3—6·4.	Cub. imp.
3 Smaltine, 472.	"	6·4—7·2.	Oct. imp.
4 *White Nickel, 470.	5·5.	7·1—7·2.	
5 *Perovskite, 424. *Prim.*	"	4·01—4·1.	Cubic.
6 Franklinite, 453. *Prim.*	5·5—6·5.	4·8—5·1.	Oct. imp.
7 Magnetic Iron Ore, 452.	"	5—5·1.	Oct. imp.
8 Iron Pyrites, 478.	6—6·5.	4·8—5·1.	Cub. imp.

CLASS II. DIMETRICA.

SECTION I. LUSTRE UNMETALLIC.

Names of Species.	Hardness.	Sp. Gravity.	Cleavage
1 *Horn Quicksilver, 300.	1—2.	6·4—6·5.	Imp.
2 Uranite, 297.	2—2·5.	3·1—3·6.	P em.
3 *Mellite, 231. *Coal.*	2—2·75.	1·5—1·7.	P and M dif.
4 Corneous Lead, 275. *Lead Ores*	2·75—3.	6—6·1.	M and the diag.
5 Molybdate of Lead, 280. " "	"	6·5—6·9.	Oct. perf.
6 Tungstate of Lead, 282. " "	"	7·9—8·1.	P. A : A=99° 43′.
7 *Edingtonite, 330. *Amyg*	4—4·5.	2·7—2·8.	M perf.
8 Tungstate of Lime, 260. *Prim*	"	6—6·1.	Oct. dist. A : A=100° 8′.
9 *Xenotime, 260.	4·25—5.	4·5—4·6.	M perf.
10 Apophyllite, 327. *Volc. &c.*	4·5—5.	2·2—2·4.	P em!
11 *Humboldtilite, 359. *Volc.*	5.	2·9—3·2.	P dist.
12 Hausmannite, 440.	5—5·5.	4·7—4·8.	P.
13 Scapolite, 357. *Prim.*	5—6.	2·6—2·8.	M dist. P trace.
14 *Œrstedite, 432. *Prim.*	5·5.	3·6—3·7.	a : a=123° 16′.
15 *Gehlenite, 359. *Prim. limestone.*	5·5—6.	2·9—3·1.	Ind.
16 *Anatase, 423. *Prim.*	"	3·8—3·9.	A & P perf. A:A=97° 56′.
17 *Fergusonite, 435. *Prim.*	"	5·8—5·9.	Ind.
18 Idocrase, 381. *Volc. and prim.*	6—6·5.	3·3—3·5.	M ind.
19 Rutile, 420. *Prim.*	"	4·1—4·3.	M.
20 Braunite, 440.	"	4·8—5.	Oct. dist.
21 *Romeine, 262. *Prim.*	6—6·5.		A : A=68°—69°.
22 Tin Ore, 427. *Prim.*	6—7.	6·5—7·1.	Ind.
23 Zircon, 417. *Volc. prim. &c.*	7·5.	4·45—4·75.	Imp.

SECTION II. LUSTRE METALLIC.

1 *Foliated Tellurium, 499.	1—1·5.	7—7·2.	Fol!
2 Copper Pyrites, 481.	3·5—4.	4·1—4·2.	Ind.
3 Hausmannite, 440	5—5·5.	4·7—4·8.	P rather perf.
4 Braunite, 440.	6—6·5.	4·8—4·9.	Oct. dist.

CLASS III. TRIMETRICA.

SECTION I. LUSTRE UNMETALLIC.

Names of Species.	Hardness.	Sp. Grav.	Form. M : M.	Cleavage.
1 Talc, 315. *Prim. amyg*	1—1·5.	2·7—2·9.	Rbc. 120° nearly.	P fol!
2 Copper Froth, 294. *Cop. ores.*	"	3—3·1.	Rbc.	P fol.
3 Orpiment, 509.	1·5—2.	3·4—3·6.	Rbc. 100° 40′.	ĕ fol!
4 Sulphur, 510.	1·5—2·5.	2—2·1.	Rbc. Oct.	Ind.
5 *Haidingerite, 240. *Prim.*	"	2·8—2·9.	Rbc. 100°.	P perf!
6 Nitre, 224.	2.	1·9—2.	Rbc. 120°.	M and ĕ imp.
7 Epsom Salt, 221.	2—2·5.	1·7—1·8.	Rbc. 90° 38′.	ĕ perf.

Lustre.	Color, Diaphaneity, &c.
1 Met.	C. Silver-w . . rdh: St. gyh-bk. Hemihedral, cubic.
2 Met	C. pale steel-gy; tarnish rdh: Brittle. Cubic.
3 Met.	C. tin-w . . steel-gy: St. gh-bk. Faces of cube often curved.
4 Met.	C. tin-w.
5 Met-ad.	C. gyh to iron-bk: St. gyh: Opaque.
6 Met.	C. iron-bk: St. dark rdh-bn. Brittle.
7 Met.	C. iron-bk: St. bk.
8 Met.	C. yw; tarnish gyh-bk: St. bnh-bk. Brittle.

CLASS II. DIMETRICA.

SECTION I. LUSTRE UNMETALLIC.

Lustre.	Color, Diaphaneity, &c.
1 Ad.	C. ywh-gy, ash-gy, ywh-w: St. w: Trl—sbtrl: Sectile.
2 P p'rly, M ad.	C. bright gn, yw: St. paler: Trp—sbtrl.
3 Res . . vit.	C. honey-yw; rh, bnh: St. w: Trp—trl: Sectile.
4 Ad.	C. w; gyh, ywh, gnh: St. w: Trp—trl.
5 Res.	C. wax-yw; orange-yw; gyh-w, olive-gn: St. w: Sbtrp—sbtrl.
6 Res.	C. gn, gy, bn; r: St. w: Faintly trl—op.
7 Vit.	C. gyh-w: St. w: Trl. Brittle.
8 Vit . . ad.	C. w, ywh-gy, y, rdh-bn: St. w: Sbtrp—sbtrl. Brittle.
9 Res.	C. ywh-bn: St. pale-bn: Op.
10 P p'rly, M vit.	C. w; gyh, rdh, bh: St. w: Trp—op. Brittle.
11 Vit.	C. y, ywh-gy, bn: Sbtrp.
12 Submet.	C. bnh-bk: St. dark rdh-, or chesnut-bn: Op.
13 Vit . . p'rly.	C. w, gy, b, rdh; colors light: St. gyh-w: Trp—op.
14 Splendent.	C. bn.
15 Res . . vit.	C. gy, ywh: Sbtrl—op: not bright: St. w, gyh-w.
16 Met. ad.	C. bn, indigo-b: St. w: Sbtrp—op.
17 Vit.	C. dark bnh-bk: St. pale-bn: Trl. and pale in thin scales; Sbtrl—op.
18 Vit . . res.	C. bn, gn, yw, colorless; often bright; St. w, gyh-w: Trp—sbtrl.
19 Met-ad.	C. rdh-bn, r: St. pale-bn: Trl—op.
20 Submet.	C. dark bnh-bk: St. similar: Op: Brittle.
21	C. hyacinth-yw, honey-yw.
22 Ad.	C. bn, bk; w, gy, yw, r: St. gy—pale-bn: Sbtrp—op. Brittle.
23 Ad.	C. r, bn, yw, gn, gy, w: St. w: Trp—sbtrl.

SECTION II. LUSTRE METALLIC.

1 Met.	St. and C. bkh-lead-gy: Flexible in thin lam. Sectile.
2 Met.	C. brass-yw: St. gnh-bk; a little shining: Brittle.
3 Submet.	C. bnh-bk: St. rdh, chesnut-bn.
4 Submet.	C. dark bnh-bk: St. similar: Brittle.

CLASS III. TRIMETRICA.

SECTION I. LUSTRE UNMETALLIC.

Lustre.	Color, Diaphaneity, &c.
1 Pearly.	C. light-gn—w: St. w: Sbtrp—trl: Feel soapy: Lam. flex. inelastic.
2 P'rly, M vit.	C. apple-gn . . sky-b: St. paler: Lam. flex.
3 P'rly; met-p'ly;	C. lemon-yw: St. yw: Sbtrp—sbtrl: Lam. flex., inelastic.
4 Res.	C. yellow: Trp—sbtrl: Sectile. Burns with a blue flame.
5 Vit.	C. w: St. w: Trp—trl: Lam. flexible. Often botryoidal.
6 Vit.	C. w: Taste saline and cooling. Deflagrates on burning coals.
7 Vit.	C. w: T. saline and bitter.

Names of Species.	Hardness.	Sp. Grav.	Form, M : M.	Cleavage.
1 White Vitriol, 226.	2—2·5.	2—2·1.	Rbc. 90° 42′.	ĕ perf.
2 *Thenardite, 221.	"	2·7—2·8.	Rbc. 125°.	P perf; M.
3 *Liroconite, 291. *Cop. ores.*	"	2·85—3.	Rbc. 119° 43′.	Imp. M.
4 *Cryolite, 231. *Prim.*	"	2·9—3.	Rect.	P perf; M̆ and M̄.
5 Rhombic Mica, 322. *Prim.*	"	2·8—3·1.	Rbc. 120° nearly.	Fol!
6 *Bromlite, 255.	2·5.	3·7–3·72.		Ind.
7 *Hopeite, 266. *Zinc ores.*	2·5—3.	2·4—2·8	Rbc. 101° 24′.	ĕ perf!
8 Picrosmine, 312. *Prim.*	"	2·55–2·7.	Rect.	M̄ perf; M̆.
9 *Polyhalite, 228.	"	2·7—2·8.	Rbc. 115°.	
10 Mascagnine, 222.	"		Rbc.	ĕ perf.
11 White Antimony, 261. *Antimony ores.*	"	5·5—5·6.	Rbc. 136° 58′.	M. em.
12 *Melanochroite, 283. *Lead ores.*	"	5·7—5·8.		
13 Anglesite, 277. *Lead ores.*	"	6·2—6·3.	Rbc. 103° 49.′	Imp.
14 *Caledonite, 284. *Lead ores.*	"	6·4.	Rbc. 95°.	ĕ dist. M ind.
15 *Cerasite, 275. *Lead ores.*	"	7—7·1.	Rbc. 102° 27′.	M perf!
16 *Roselite, 273.	"		Rbc. 132° 48.	ĕ perf!
17 Heavy Spar, 257.	2·5—3·5.	4·3—4·8.	Rbc. 101° 40′.	M and P.
18 Celestine, 254.	2·75–3·5.	3·9—4.	Rbc. 104°–104° 30′	M dist. P.
19 Olivenite, 292.	3.	4 1—4·3.	Rbc. 110° 50′.	Imp.
20 *Fluellite, 234.	"		Rbc. 105°—oct.	
21 *Villarsite, 311. *Dolomite*	3—3·5.	2·9—3.	Rbc. 119° 59′.	
22 Anhydrite, 241.	"	2·89—3.	Rect. M : e = 135° 35′	M̄ and M̆ perf. P dist.
23 *Atacamite, 293. *Volc. &c.*	"	4—4·4	Rbc. 107° 10′.	P perf.
24 White Lead, 274.	"	6·1—6·5.	Rbc. 117° 13′.	M perf.
25 Witherite, 256.	3—3·75.	4·2—4·4.	Rbc. 118° 30′.	Imp.
26 Serpentine, 309.	3—4.	2·5—2·6.	Rect.	
27 *Mesole, 334. *Amyg.*	3·5—4.	2·3—3·4.	Rbc.	Perf. in one direction.
28 Strontianite, 253.	"	3·6—3·8.	Rbc. 117° 19′.	M nearly perf.
29 Wavellite, 233. *[prim.*	3·25—4.	2·2—2·4.	Rbc. 122° 15′.	M and ĕ perf.
30 Stilbite, 328. *Amyg. and*	3·5—4.	2·1—2·2.	Rect. e : e = 93°.	M̆ perf! M̄ imp.
31 Arragonite, 246.	"	2·9—3.	Rbc. 116° 10.	M.
32 Scorodite, 269.	"	3·1—3·3.	Rbc. 119° 2′.	M and ĕ imp.
33 *Brochantite, 295. *Cop. ores.*	"	3·7—3·8.	Rbc. 114° 20′.	Imp.
34 *Libethenite, 292.	4.	3·6—3·8.	Rbc. 95° 2′.	Imp.
35 Epistilbite, 329. *Amyg. volc.*	4—4·5.	2·2—2·3.	Rbc. 135° 10′.	ĕ perf.
36 *Harmotome, 331. *Amyg.,*	"	2·4—2·5.	Rect.	Imp.
37 Red Zinc Ore, 426. *[&c.*	"	5·4—5·6.	Rbc. 125°.	P. fol!
38 *Phillipsite, 332. *Amyg. volc.*	4·5.	2—2·2	Rect.	Imp.
39 Electric Calamine, 265.	4·5—5.	3·3—3·5.	Rbc. 103° 53′.	M perf.
40 Thomsonite, 330. *Amyg.*	4·75.	2·25–2·4.	Rect. e : e = 90° 40′.	M̄, M̆ perf!
41 *Euchroite, 289. *Prim.*	"	3·3—3·4.	Rbc. 117° 20′.	M dist.
42 Natrolite, 332. *Volc. amyg.*	4·5—5·5.	2·1—2·3.	Rbc. 91° 10′.	M perf.
43 *Childrenite, 235	"	4·2—4·3.	Rbc e : e = 97° 50′.	Imp.
44 *Herderite, 234. *Prim.*	5.	2·9—3·1.	Rbc. 115° 53′.	Imp.
45 *Triphyline, 269. *Prim.*	"	3·6.	Rbc. 132°.	P perf.
46 *Göthite, 450.	"	4·0—4·2.	Rbc. 130° 14′.	ĕ.
47 Wolfram, 439. *Prim.*	5—5·5.	7·1—7·4.	Rect. e′ : e′ = 101° 5′.	M perf.
48 Scolecite, 335. *Volc. amyg.*	5—6.	2·2—2·3.	Rbc. 91° 35′.	
49 Lazulite, 347.	"	3—3·1.	Rbc. 91° 30′.	Ind.
50 Brookite, 424.	5·5—6.		Rbc. 100°.	M. ind.
51 Yenite, 448. *Prim.*	"	3·8—4·1	Rbc. 112° 37′.	ĕ. ind.
52 Polymignite, 433. *Prim.*	6·5—7.	4·7—4·9.	Rect.	Ind.
53 Prehnite, 343. *Amyg. prim.*	6—7.	2·8—3.	Rbc. 99° 56′.	P.
54 *Humite, 389. *Volc.*	6·5—7.	3·1—3·2.	Rbc. 120°.	ĕ.
.. Chrysolite, 403. *Volc. basalt.*	"	3·3—3·5.	Rect.	M.
56 Iolite, 406. *Prim.*	7—7·5.	2·55–2·7.	Rbc. 120°.	Ind.
57 Staurotide, 385. *Prim.*	"	3·6—3·8.	Rbc. 129° 20′.	ĕ ind.
58 Andalusite, 386. *Prim.*	7·5	3·1–3·35.	Rbc. 91° 33′.	M dist.
59 *Ostranite, 418.	6—6·5.	4·3—4·4.	Rbc. 96°.	ĕ ind.
60 *Forsterite, 403. *Vesuv.*	7·5—8.		Rbc. 128° 54′.	P perf!
61 Topaz, 401. *Prim.*	8.	3·4—3·6.	Rbc. 124° 19′.	P perf!
62 Chrysoberyl, 394. *Prim.*	8·5.	3·5—3·8	Rect.	M̆ dist.

Lustre.	Color, Diaphaneity, &c.
1 Vit.	C. w: Trp—trl: T. astringent, metallic, very nauseous.
2 Vit.	C. w: Trp: T. saline and bitter; wholly soluble: Efflorescent.
3 Vit.. res.	C. and St. light b—gn: Sbtrp—trl.
4 Vit.. p'rly.	C. w; rdh, bnh: St. w: Sbtrp—trl: Fusible in flame of a candle.
5 Pearly.	C. bnh-r, gyh-bn: Laminæ thin and elastic.
6 Vit.	C. w; Trl.
7 Vit; ĕ subp'rly.	C. gyh-w: rdh-bn: St. w; Trp—trl. Double refraction.
8 M. p'rly; vit.	C. gnh-w, dark gn: St. w: Sbtrl—op.
9 Res., little py.	C. flesh or brick r. or ywh: Trl—op: T. bitter, weak.
10 Vit.	C. ywh-gy—lemon-yw. Trl. T. pungent and bitter.
11 Ad and p'rly.	C. w; peach-blossom-red, ash-gy: St. w: Trp—trl. Very fusible.
12 Res. glim.	C. btwn cochineal and hyacinth-r; lemon-yw on exposure: St. brick-red: Sbtrl—op.
13 Ad; vit; res.	C. w, gyh, ywh, gnh, bn, ash-gy: St. w: Trp—sbtrl.
14 Res.	C. deep verdigris or bh-gn: St. gnh-w: Trl.
15 P'rly.	C. ywh-w, rdh-w: St. w: Feebly trl—op.
16 Vit.	C. deep rose-r: St. w: Trl.
17 Vit.. p'rly & res.	C. w; ywh: St. w: Trp—trl—op.
18 Vit;.. p'rly & res.	C. w, often bluish: St. w: Trp—trl. Brittle.
19 Ad.. vit & p'rly.	C. gn, bn: St. olive-gn—bn: Sbtrp—op.
	C. w: trp.
21 Vit.	C. ywh-gn: Sbtrp: Fr. granular.
22 P'rly and vit.	C. w: St. gyh-w: Trp—trl: Often fibrous and foliated.
23 Ad., vit.	C. some shade of gn: St. pale-gn: Sbtrp—sbtrl.
24 Ad., res.; p'rly.	C. w, gyh, bnh: St. w, gyh-w: Trp—trl: Brittle.
25 Vit.. res.	C. w, ywh-gy: St. w: Sbtrp—trl. Brittle.
26 Res.. greasy.	C. dark and light-gn, oil-green: St. w: Trl—op.
27 Silky or p'rly.	C. gyh-w, ywh-w: St. w: Trl: Lam. slightly elastic.
28 Vit.	C. light-gn, w: Trp—trl.
29 P'rly.. vit & res.	C. w, gn, b, yw, bn: St. w, gyh-w: Trl. In hemispherical concretions.
30 M p'rly.	C. w; ywh, rh, bnh: St. w: Sbtrp—trl.
31 Vit—res.	C. w; gyh, ywh: St. gyh-w: Trp—trl.
32 Vit, subad. res.	C. leek-gn, liver-bn: St. w: Sbtrp—sbtrl.
33 Vit.	C. emerald-gn, bkh-gn: Trp.
34 Res.	C. dark olive-gn: St. olive-gn: Sbtrl.
35 ĕ p'rly, M vit.	C. and St. w: Trp—sbtrl.
36 Vit.	C. w; gyh, ywh, rh, bnh: St. w: Sbtrp—trl. *Crystals often cruciform.*
37 Subad.	C. deep red: St. orange yw.
38 Vit.	C. w; rdh: St. w: Trl—op. *Crystals often cruciform.*
39 Vit, p'rly.	C. w; b, gn, y, bn: St. w: Trp—trl.
40 Vit.. p'rly.	C. w; bnh, rdh: St. w: Trp—trl.
41 Vit.	C. emerald-gn: St. pale-gn: Trp—trl.
42 Vit.	C. w; ywh, rdh, gyh: St. gy: Trp—trl.
43 Vit.. res.	C. y, pale ywh-bn, ywh-w: St. w: Trl.
44 Vit.. subres.	C. ywh-w, gnh-w: St. w: Trl. Very brittle.
	C. gnh-gy; bh: St. gyh-w: Trl—sbtrl.
46 Subad.	C. bn—blood-r: St. bnh-yw, ochre-yw.
47 Submet.	C. dark gyh-bk, bnh-bk: St. dark rdh-bn: Op.
48 Vit.. p'rly.	C. and St. w: Trp—trl.
49 Vit.	C. b: St. w: Sbtrp—op. Fracture even. Brittle.
50 Met-ad.	C. hair-bn, orange-yw: St. ywh-w: Trl—op.
51 Submet.	C. dark gyh-bk, nearly iron-bk: St. gnh, or bnh-bk: Op. Brittle.
52 Submet, splend.	C. bk: St. dark-bn: Opaque. Fr. perfect conchoidal.
53 Vit, P p'rly.	C. light-gn—w: St. w: Sbtrp—trl: Often aggregated in glob. shapes.
54 Vit.	C. ywh-w, rdh-bn: Trp—trl: Brittle: Cryst. small; from Vesuvius.
55 Vit.	C. gn, light-bn: St. w: Trp—trl.
56 Vit.	C. light-b; bkh, ywh, gyh: St. w: Trp—trl. Exhib. dichroism.
57 Vit, subres.	C. rdh-bn, bn, bk: St. w: Trl—op; usually the latter.
58 Vit.	C. flesh-r, pearl-gy: St. w: Sbtrl—op: Tough.
59 Vit.	C. clove bn: St. lighter bn: Very brittle.
60 Vit, splend.	Colorless: St. w: Trl.
61 Vit.	C. pale y, gn—w: St. w: Trp—sbtrl: Op.
62 Vit.	C. gn; ywh, gyh: St. w: Trp—trl.

SECTION II. LUSTRE METALLIC.

Names of Species.	Hardness.	Sp. Grav	Form, M : M.	Cleavage.
1 *Sternbergite, 490.	1—1·5.	4·1—4·3	Rbc. 119° 30′.	P em ! fol.
2 *Graphic Tellurium, 466.	1·5—2.	5·7—5·8	Rbc. 107° 44′.	M perf ! P perf.
3 *Auro-Tellurite, 466.		10·6-10·7	Rbc. 105° 30′.	Ind.
4 Gray Antimony, 491.	2.	4·5—4·7	Rbc. 90° 45′.	ĕ perf ! M ind.
5 Pyrolusite, 442.	2—2·5.	4·8—5.	Rbc. 93° 40′.	M, ĕ, ē.
6 *Antim. Sulph. Silver, 490.	"	5·5—5·6	Rbc. 100° 8′.	M perf.
7 Sulphuret of Bismuth, 500.	"	6·5—6·6	Rect. e : e=91°30′.	M perf. P imp.
8 *Brittle Silver Ore, 489.	"	6·2—6·3	Rbc. 115° 39′.	Imp.
9 *Jamesonite, 494.	"	5·5—5·8	Rbc. 101° 20′.	P perf. M ind.
10 Vitreous Copper, 486.	2·5—3.	5·5—5·8	Rbc. 119° 35′.	M ind.
11 *Bournonite, 484.	"	5·7—5·8	Rect.	Imp.
12 *Zinkenite, 493. *Antim. ores.*	3·5.	5·3—5·4	Rbc. 120° 39′.	None.
13 *Antimonial Silver, 467.	3·5—4.	9·4—9·8	Rbc. 120° ?	P dist.
14 Manganite, 441.	4—4·5.	4·3—4·4	Rbc. 99° 40′.	ē.
15 Wolfram, 439. *Prim.*	5—5·5.	7·1—7·4	Rect. e′ : e′=101° 5′	M perf.
16 Leucopyrite, 474.	"	7·2—7·4	Rbc. 122° 26′.	
17 Yenite, 448.	5·5—6.	3·8—4·1.	Rbc. 112° 37′.	Ind.
18 Columbite, 436. *Prim.*	5—6.	5·9—6·1	Rect.	Ind.
19 Mispickel, 475. *Prim.*	"	6·1—6·2	Rbc. 111° 53′.	M.
20 *Ferrotantalite, 438.	"	7·2—8.	Rect.	Imp.
21 White Iron Pyrites, 477.	6—6·5.	4·6—4·9.	Rbc. 106° 36′.	M.
22 *Polymignite, 433. *Prim.*	6·5.	4·7—4·9.	Rect.	Ind.

CLASS IV. MONOCLINATA.

SECTION I. LUSTRE UNMETALLIC.

Names of Species.	Hardness	Sp. Grav	Form.†	Cleavage
1 Natron, 218.	1—1·5.	1·4—1·5	Rbc. 71° 17′.	
2 *Red Antimony, 505.	"	4·4—4·6	Rbdl. 101° 19′.	M perf.
3 Glauber Salt, 220.	1·5—2.	1·4—1·5	Rbc. 86° 31′.	
4 *Borate of Lime, 243.			Rbc. 97° 30′.	
5 *Cobalt Bloom, 273.	1·5—2.	2·9—3.	Rbdl. 124° 51′.	P perf !
6 Vivianite, 270.	"	2·6—2·7	Rbdl. 125° 18′.	P em !
7 *Realgar, 508.	"	3·3—3·6.	Rbc. 74° 30′.	Imp.
8 Copperas, 224.	2.	1·8—1·9.	Rbc. 82° 21′.	P perf., M imp.
9 Gypsum, 240.	"	2·3-2·35.	Rbdl. 113° 18′.	P perf ! M & T imp.
10 *Borax, 215.	2—2·5.	1·716.	Rbdl. 106° 6′.	M perf.
11 *Botryogen, 227.	"	2·039.	Rbc. 119° 56′.	M.
12 *Pharmacolite, 239.	"	2·6—2·8.	Rbdl. 96° 46′.	P em !
13 Common Mica, 320.	"	2·8—3.	Rbc. about 120°.	Fol ! !
14 *Johannite, 227.	"	3·1—3·2.	Rbc. 111° ?	
15 *Miargyrite, 506.	"	5·2—5·4.	Rbc. 86° 4′.	M imp.
16 *Dioxylite, 276. *Lead ores.*	"	6·8—7.	Rbc. 120° 45′.	ĕ perf.
17 *Gay-Lussite, 218.	2·5.	1·9—2.	Rbc. 68° 50′.	M perf ; P dist.
18 Oxalate of Iron, 230.	"	2·75.	Rbc. 100° 36′.	P ; M imp.
19 *Leadhillite, 276. *Lead ores.*	"	6·2—6·5.	Rbc. 59° 40′.	P perf.

† The angle given is M : M, when the primary is an oblique rhombic prism, and

SECTION II. LUSTRE METALLIC.

Lustre	Color &c.
1 Met	C dark pinchbeck bn St bk Lam flex bk tin foil Sectile
2 Met	C and St steel-gy very sectile
3 Met	C Silver-w—brass-yw St similar Rather brittle
4 Met	C and St lead gy steel-gy, tarnishes Sectile
5 Met	C iron bk, bh St bk Somewhat sectile
6 Met	C and St light steel gy silver w, bkh—lead-gy
7 Met	C and St lead-gy Sectile
8 Met	C and St iron-bk Sectile
9 Met	C and St steel-gy Sectile
10 Met	C and St bkh-lead-gy, tarnish b gn Sectil
11 Met	C and St steel-gy, bkh gy Brittle
12 Met	C and St steel gy
13 Met	C and St silver-w—tin w Not malleable
14 Submet	C dark steel-gy, iron bk St rdh bn, bk Brittl
15 Submet	C dark gyh-bk, bnh-bk St dark rdh-bn Brittle
16 Met	C silver-w steel-gy St each bk Brittle
17 Submet	C nearly iron bk dark gyh bk St gnh bk, bnh bk Brittle
18 Submet	C gyh bnh bh bx St bn [illegible] bn bnh bk Brittle
19 Met	C silver w, steel gy St dark gy Brittle
20 Nearly met	C iron-bk St rdh-bn Brittle
21 Met	C pale bronze yw, gyh, gnh St dark gyh bk Brittle
22 Submet	C bk St dark bn Fracture perfect, conchoidal brittle

CLASS IV. MONOCLINATA.

SECTION I. LUSTRE UNMETALLIC.

Lustre	Color Diaphaneity &c.
1 Vit, earthy	C w, gyh, ywh T alkaline—Efflor usually in crusts
2 Ad	C cherry r St bnh-r Trl—sbtrl Sectile [efflor crusts
3 Vit, earthy	C w Trp—op T cool then feebly saline and bitter Usually in
4	C crystals colorless—trp also snowy fibrous and odorous
5 P'rly & ad—vit	C r gyh St paler Trp—sbtrl Lam flex in one direction
6 P'rly—submet	C b gn, indigo b St b, bn Trp—trl Lam flex
7 Res	C bright-r St orange-yw—aurora r Sectile
Vit	C gn, wh St w Sbtrp—trl T sweetish astringent and metallic
9 P'rly and vit	C w, gyh, ywh St w Trp—trl Tasteless Very sectile
10 Res	C w, gyh, bh, gnh, ywh on exposure St w T sweetish alkaline feeble Intumesces and then fuses
11 Vit	C deep hyacinth-r, ochre-yw St ochre yw T slightly astringent
12 P'rly and vit	C w, gyh, rdh St w Trl—op
13 P'rly, vit ad	C various St w—gy Lam tough highly elastic
14 Vit	C emerald-gn, apple gn St ywh gn Trp op T slightly bitter
15 Submet ad	C iron bk St dark cherry r Sbtrl—op
16 P'rly and res	C gnh-w, ywh, gyh St w Trp—trl
17 Vit	C w Trp Very brittle Partially soluble
18 Res	C w Brittle
19 Res; ad	C w, ywh, gnh, gyh St w Trp—trl Rather sectile

M. T, when it is the right rhomboidal prism

Names of Species.	Hardness.	Sp. Grav.	Form; M : M.	Cleavage.
1 *Trona, 219.	2·5—3.	2·11.	Rbdl. 103° 15′.	M perf.
2 *Glauberite, 228. [ores.	"	2·7—2·9.	Rbc. 83° 20′.	P perf.
3 Atacamite, 293. Copper	"	4·43.	Rbc. 107° 10′.	P perf.
4 *Aphanesite, 290.	"	4·1—4·2.	Rbc. 56°.	P em.
5 Cupreous Anglesite, 284. Lead ores.	"	5·3—5·5.	Rbdl. 95° 45′.	M and T perf!
6 Vauquelinite, 283. Lead ores.	"	5·5—5·8.	Rbc.	
7 *Chromate of Lead. 282.	"	6—6·1.	Rbc. 93° 40′.	M rather dis.
8 Haydenite, 342, 526. prim	3.	2·1—2·3.	Rbc. 98° 22′.	P perf.
9 Heulandite, 324. Amyg	3·5—[illegible]	2·15-2·2.	Rbdl. 130° 30′.	P fol!
10 Laumonite, 326. Prim.,amy	"	2·3.	Rbc. 86° 15′.	ĕ dist.
11 *Brochantite, 295.	"	3·7—3·8.	Rbc. 114° 20′.	In traces, M.
12 Green Malachite, 286. Copper ores.	"	4—4·1.	Rbc. 103° 42′.	P perf!
13 Azurite, 286.	3·5—4·25.	3·5—3·9.	Rbc. 98° 50′.	M.
14 *Margarite, 320. Prim.	3·5—4·5	3—3·1.	Hexag. tables.	Fol.
15 *Huraulite, 267. Gran.	about 4.	2·2—2·3.	Rbc. 117° 30.	None.
16 *Baryto-calcite, 255.	4.	3·6—3·7.	Rbc. 106° 54′.	M perf.
17 Clintonite, 314.	4—5.	3—3·1.	Rbc. 94°.	Fol.
18 *Turnerite, 374. Prim.	4·5—5.		Rbc. 96° 10′.	ĕ and ĕ.
19 Pseudo-malachite, 291. Copper ores.	"	4·2—4·3.	Rbc. 141° 04′.	Ind.
20 Monazite, 424. Prim.	5.	4·8—5·1.	Rbc. 93° 10′.	P perf.
21 *Brewsterite, 325. Amyg., prim.	5—5·5.	2·1—2·5.	Rbdl. 93° 40′.	P perf!
22 Datholite, 342. Amyg. prim	5·5—6.	2·95—3.	Rbc. 77° 30′.	Ind.
23 *Wagnerite, 234.	"	3—3·2.	Rbc. 95° 25′.	
24 Anthophyllite, 372. Prim.	"	3·1—3·2.	Rbc. 125° 30′.	ē perf; M and ĕ.
25 Sphene, 421 Prim.	"	3·2—3·5.	Rbc. $n:n=136°8′$.	Ind.
26 Hornblende, 368 Prim. volc. &c.	5—6.	2·9—3·4.	Rbc. 124° 30′.	M perf ĕ, ē sometimes perf.
27 Pyroxene, 364. Prim. volc. &c.	"	3·2—3·5.	Rbc. 87° 5′.	M dist.
28 *Æschynite, 432 Prim.	"	5·1—5·7.	Rbc. 127°.	
29 Acmite, 373. Prim.	5·5—6.	3·2—3·4.	Rbc. 86° 56′.	M ind.
30 Warwickite, 455. Prim.	"	3—3·3.	Rbc.	ē perf.
31 Allanite, 429. Prim.	"	3·3—3·8.	Rbc. 128°.	Ind.
32 Feldspar, 348.	6.	2·3—2·6.	Rbc. 118° 49′. P : T =67° 15′.	P perf, ē less so; T ind.
33 *Ryacolite, 351. Volc.	"	2·5—2·7.	Rbc. 119° 21′.	P perf.
34 *Greenovite, 423. Prim.	above 5.	3·4—3·6.	Rbc. 110° 35′.	
35 *Amblygonite, 374. Granite	6.	3—3·1.	Rbc. 106° 10′.	M. perf.
36 *Heterozite, 267. [limest.	"	3·3—3·6.	Rbc. (cleavage.)	P and M.
37 Chondrodite, 388. Prim.	6—6·5.	3·1—3·2.	Rbc. 112° 12′.	
38 Epidote, 379. Prim.	6—7.	3·2—3·5.	Rbdl. 115° 24′.	M.
39 Ligurite, 104. Talcose rock.	"	3·49.	Rbc. 140°.	
40 Spodumene, 360. Prim.	6·5—7.	3·1—3·2.	Rbc. 93°.	M perf.
41 Gadolinite, 431. Granite.	"	4—4·3.	Rbc. 115°?	Ind.
42 Euclase, 393. Prim.	7·5.	2·9—3·1.	Rbdl. 130° 50′.	P perf!

SECTION II. LUSTRE METALLIC.

1 *Flexible Silver Ore, 491.	very soft.		Rbdl. 125°.	Cleav!
2 *Miargyrite, 506.	2—2·5.	5·2—5·4.	Rbc. 86° 4′.	M imp.
3 Wolfram, 439.	5—5·5.	7·1—7·4.	Rbc.	M̄ perf.
4 *Plagionite, 494.	2·5.	5·4.	Rbc. 120° 49′.	M perf.
5 *Placodine, 471.	5—5·5.	7·9—8·1.	Rbc. 64° 32′.	Imp.
6 Warwickite, 455. Prim.	5·5—6.	3—3·3.	Rbc.	ĕ perf.
7 Allanite, 429. Prim.	"	3·3—3·8.	Rbc. 128°.	Imp.
8 *Heteroclin, 443	6	[illegible]—4·7.	Rbc 128° 16′.	Imp.

Lustre.	*Color, Diaphaneity, &c.*
1 Vit.	C. w; ywh: St. w: Trp—trl: Taste sharply alkaline.
2 Vit.	C. ywh-w, gyh-w: St. w: Sbtrp—trl: T. feebly saline and astring.
3 Ad . . vit.	C. gn; bkh-gn: St. apple green: Trl—sbtrl.
4 P'rly.	C. dark-gn . . b: St. bh-gn: Sbtrl.
5 Ad., vit.	C. azure-b: St. pale-b: Trl—sbtrl.
6 Ad.	C. dark-gn; nearly bk: St. siskin-gn, bnh: Sbtrl—op.
7 Ad . . vit.	C. bright r: St. orange-yw: Trl: Sectile.
8 Vit.	C. bnh, gnh, or wine-yw: Trp—trl: Brittle.
9 P'p'rly, M vit.	C. w; r, g, bnh: St. w: Trp—sbtrl.
10 Subp'rly, vit.	C. w; ywh, gyh: Trp—trl. Soon opaque white on exposure.
11 Vit.	C. emerald-gn: Trp.
12 Ad . . vit.	C. gn: St. paler-gn: Trl—sbtrl.
13 Vit.	C. azure-b: St. pale-b: Trp—sbtrl.
14 P'rly.	C. pearl-gy . . rdh-w, ywh-w: St. w: Trl—sbtrl. Rather brittle.
15 Vit.	C. rdh-yw: Trp.
16 Vit . . res.	C. w; gyh, ywh, gnh: St. w: Trp—trl.
17 Met., met-p'rly.	C. rdh-bn, ywh-bn, copper-r: St. ywh-gy: Lam. scarcely flexible.
18 Ad.	C. y, bn: St. w, gyh-w: Trp—trl.
19 Ad . . vit.	C. gn: St. paler-gn: Trl—sbtrl.
20 Res.	C. bn, bnh-r, bnh-yw: St. lighter: Sbtrp—op: Brittle.
21 Vit.	C. w; gnh, ywh, rdh: St. w: Trp—trl.
22 Vit.	C. w; ywh, gyh: Trp—trl.
23 Vit.	C. y; gyh: St. w: Trl.
24 P'rly—submet.	C. ywh-gy, bnh-gn, clove-bn: St. w: Trl—sbtrl: Often thin col.
25 Ad; res.	C. bn, bk, y, gyh, gnh: St. w: Trl—op: Brittle.
26 Vit, p'rly.	C. gn, bn, bk, w: St. gyh-w: Sbtrp—op.
27 Vit . . res.	C. gn, bn, gy, w, bkh: St. w—gy: Trp—op.
28 Res, submet.	C. bk, dark bnh-yw: St. dark-gy, nearly bk. Trl—op.
29 Vit, res.	C. bnh-bk, ywh, gnh-bk: St. pale gnh-gy: Sbtrl—op.
30 Submet—p'rly.	C. bn, iron-bk: Brittle.
31 Submet, res; vit.	C. pitch-bn, bnh-bk: St. gy, gnh-gy, bnh-gy: Sbtrl—op: Brittle.
32 Vit: p'rly.	C. w, gy; gnh, rdh, bh: St. w—gy: Trp—sbtrl.
33 Vit; p'rly.	C. gyh-yw, w or colorless: Trp: Fr. conch.
34 Vit, splend, gr'sy	C. rose and flesh-r: St. rdh.
35 Vit . . p'rly.	C. pale-gn; w: St. w: Sbtrp—trl
36 Res.	C. gnh, bh-gy; violet after exposure, with submetallic lustre.
37 Vit . . res.	C. yw, bn, r, apple-gn, bk: St. w, ywh: Trp—sbtrl: Very brittle.
38 Vit . . p'rly.	C. gn; yw; gy, rdh: St. gy—w: Sbtrp—trl
39 Vit.	C. apple-gn; [illegible]
40 P'rly.	C. gyh, ywh-w: St. w: [illegible]
41 Vit . . res.	C. dark gnh-bk: St. gnh-gy. Sbtrl—op.
42 Vit.	C. pale mountain-gn, bh, w: Trp—sbtrp: Fragile.

SECTION II. LUSTRE METALLIC.

1 Met.	C. externally nearly bk: Lam. flexible.
2 Submet—ad.	C. iron-bk: St. dark cherry-red: Very sectile.
3 Submet.	C. dark-gyh, or bnh-bk: St. dark rdh-bn.
4	C. bkh lead-gy: Brittle.
5 Met.	C. bronze-yw: St. bk.
6 Submet, pearly.	C. dark-bn to iron-gray: Brittle.
7 Submet, res.	C. pitch-bn, bnh-bk: St. gnh-gy. bnh-gy: Op: Brittle.
8 Submet.	C. iron-bk, steel-gray.

CLASS V. TRICLINATA.

Names of Species.		Hardness.	Sp. Grav.	P : M, P : T, M T.	Cleavage.
1 Blue Vitriol, 226.		2·5.	2·2—2·3.	109° 32′, 127° 40′, 123° 10′.	Imp.
2 *Pyrallolite, 308.	Prim.	3·5—4.	2·5—2·6.	140° 49′, 94° 36′.	M, T; e.
3 Schiller Spar, 313.	Serp.	"	2·6—2·7.	M : T between 135° and 145°.	Foliated.
4 Tabular Spar, 361.		4—5.	2·7—2·9.	93°40′,126°?95°15′	Perf.
5 Babingtonite, 368.	Granite.	5·5—6.	3·4—3·5.	92°34′,88°,112°30′	P perf.
6 *Latrobite, 356.	Prim.	5·5—6·5.	2·7—2·8.	91°9′,98°30′,93°30′	P, M, T.
7 Kyanite, 375.	Prim.	5—7.	3·5—3·7.	93° 15′, 100° 50′, 106° 15′.	M dist.
8 Albite, 352.	Prim.	6.	2·6—2·7.	93° 50′, 115° 5′ 117° 53′.	P perf, M and T less so.
9 *Oligoclase, 355		"	2·6—2·7.	93° 45′, 115° 30′.	P very dist.
10 *Andesin, 353.		"	2·71.	Like Albite nearly.	
11 *Anorthite, 354.	Volc.	"	2·65–2·8.	110° 57′, 120° 30′.	P and M.
12 Labradorite, 355.	Prim.	"	2·65–2·8.	93° 28′, 114° 48′, and 119° 16′.	P and M.
13 Manganese Spar, 362.	Prim.	6—7.	3·4—3·7.	93° to 94°, 112° 30′, 121°.	P perf.
14 *Diaspore, 377.	Prim.	6—6·5.	3·4—3·5.	71°30′, 78°40′, 65°.	Diagonal perf!
15 Axinite, 407.	Prim.	6·5—7.	3·2—3·3.	134° 40′, 115° 5′, 135° 10′.	Imp.
16 Sillimanite, 377.	Prim.	7—7·5.	3·2—3·3.	M : T=98°, 110°.	Diag. perf!

CLASS VI. HEXAGONA.

SECTION I. LUSTRE UNMETALLIC.

Names of Species.		Hardness.	Sp. Grav.	Form, R . R.	Cleavage.
1 Nitrate of Soda, 223.		1·5—2.	2·0964.	Rbdn 106° 33′.	R perf.
2 Brucite, 314.	Serp.	1·5.	2·35.	Hexag. tables.	P fol!
3 Coquimbite, 225.		1·5—2.		Hexag. pm.	M imp.
4 Chlorite, 317.		"	2·6—2·9.	Hexag.	Fol!
5 *Copper Mica, 293.	Cop.	2.	2·5—2·7.	Rbdn. 68° 45′.	a, eminent.
6 Hexagonal Mica, 322.	ores.	2—2·5.	2·8—3·1.	Hexag. pm.	P fol.
7 *Pennine, 318.	Prim.	2—2·53.		Rhom. tables.	Fol!
8 Chlorophyllite, 306.	Prim.	1·5—3·5.	2·7–2·75.	Hexag. pm.	P fol.
9 *Gigantolite, 307.	Prim.	2—3·5.	2·8—2·9.	Hexag. pm.	P perf., fol.
10 *Light Red Silver, 507.		2—2·5.	5·4–5·56.	Rbdn. 107° 36′.	Imp.
11 *Cinnabar, 507.		"	7·8—8·1.	Rbdn. 71° 47′.	a, perf!
12 Pinite, 304	Prim.	"	2·7—2·8.	Hexag. pm.	P sometimes dist.
13 *Cronstedtite, 446.		2·5.	3·3—3·4.	Hexag. pms.	a, cleav!
14 *Dark Red Silver, 506.		2·5—3.	5·7—5·9.	Rbdn. 108° 18′.	Imp.
15 Vanadinite, 281.	Lead ores.	2·75.	6·6—7·3.	Hexag. pm.	
16 *Hydrargillite, 304.		2·5—3.		Hexag. pm.	P perf.
17 Calcareous Spar, 243.		2·5—3·5.	2·5—2·8.	Rbdn. 105° 5′.	R perf.
18 *Fahlunite, 305.	Prim.	3—3·5.	2·6—2·8.	Hexag. pm.	P dist.
19 *Mimetene, 279.	Lead ores.	2·75–3·5.	6·4.	Hexag. pm.	M imp.
20 *Greenockite, 505.	Trap.	3—3·5.	4·8—5.	Hexag.	Lat. dist.

CLASS V. TRICLINATA.

	Color, Diaphaneity, &c.
1 Vit.	C. sky-blue: St. w: Sbtrp—trl. Taste met.-astringent.
2 Dull; res.	C. w; gnh: St. w: Sbtrl—op: Fracture earthy.
3 Met-p'rly—vit.	C. dark-gn, pinchbeck-bn: St. gyh-w, ywh: Sbtrl.
4 Vit. . p'rly.	C. w; gyh, rh, ywh, bnh: St. w: Sbtrp—sbtrl: Often fib, fol.
5 Vit, splend.	C. dark gnh-bk: Trl—op.
6 Vit.	C. pale-red or pink: Sbtrl—op.
7 P'rly—vit.	C. b, w, gnh: St. w: Trp—trl. Crystals usually long and thin.
8 Vit. . p'rly.	C. w; gyh, rdh, bnh: St. w: Trp—sbtrl.
9 Vit. . p'rly.	C. ywh and gnh-w, w: Trp—trl: Fr. conch—uneven.
10 Vit. . p'rly.	C. w, gyh: Trl.
11 P'rly . . vit.	C. w: St. w: Trp—trl: Brittle.
12 P'rly, M and T.	C. w; gyh, rdh, bnh; play of colors: Sbtrl.
13 Vit.	C. flesh-r, bnh-r, gnh, ywh, bn: St. w: Trp—op: Becomes black on exposure.
14 Vit, splend.	C. gnh-gy or hair-bn: Trl—sbtrl.
15 Vit, splend.	C. clove-bn, bh, gyh, gnh: St. w: Trp—trl. Crystals flat and acute, with high lustre.
16 Vit. . p'rly.	C. hair-bn, gyh: Trl. Crystals slender.

CLASS VI. HEXAGONA.

SECTION I. LUSTRE UNMETALLIC.

	Color, Diaphaneity, &c.
1 Vit.	C. w, reddish, bnh, ywh: Trp: Taste cooling. Deflagrates on coals.
2 Pearly.	C. w, gyh, bh, gnh: Trl—sbtrl: Fol. flexible: Sectile.
3 ..	C. w, pale violet: Taste astringent and metallic, nauseous.
4 Vit. . p'rly.	C. olive-gn, emerald-gn; nearly white: Trp—sbtrl: Lam. not elastic.
5 a, p'rly, R vit.	C. gn: St. gn, paler than color: Trp—trl: Sectile.
6 P'rly, submet.	C. dark gn, bn, nearly bk: St. gyh-w: Lam. elastic. Lepidomelane is similar, but folia rather brittle, and St. gnh, C. bk; H.=3.
7 Vit. p'rly, subm.	C. bn, hyacinth-r, gnh, bkh-gn: Trp—trl.
8 P pearly.	C. gn, gnh, gy, bnh-gn: Folia brittle.
9 Vit, waxy; subm	C. gnh to dark steel-gy. In large hexagonal crystals.
10 Adamantine.	C. cochineal-red: St. r: Sbtrp—sbtrl.
11 Ad . . met.	C. cochineal-red—lead-gy: St. scarlet-red. Lam. easily separated.
12 Res. p'rly; glim.	C. bnh-yw; pearl-gy, rdh-bn: St. w: Sbtrl—op.
13 Vit. splend.	C. bnh-bk: St. dark leek-gn: Opaque: Lam. elastic.
14 Met-adamant.	C. iron-bk—coch-r: St. coch-r: Trl—op: Sectile.
15 Res.	C. straw-yw, bnh-yw—rdh-bn: St. w: Opaque: Brittle.
16 P pearly.	C. faint rdh-w: Trl. In small crystals.
17 Vit.	C. w, gy, rdh, ywh: St. gyh-w: Trp—trl. Sometimes soft and earthy.
18 Res; . vit.	C. gn; . . bnh, bk: St. gyh-w: Opaque.
19 Res.	C. yw—light bn: St. w: Sbtrp—opaque: Sectile.
20 Adamantine.	C. honey and orange yw: St. yw, rdh: Sbtrp.

Names of Species.	Hard	Sp. Grav.	Form, R R.	Cleavage.
1 Magnesite, 249.	3—4	2·8—3.	Rbdn. 107° 22′.	R perf.
2 *Dreelite, 256.	3·5.	3·2—3·4.	Rbdn. 93° 94′.	Ind.
3 Diallogite, 253.	"	3·5—3·6	Rbdn. 106° 51′.	R.
4 Dolomite, 248.	3·5—4.	2·8—3.	Rbdn. 106° 15′.	R perf.
5 Ankerite, 249.	"	2·9—3·2.	Rbdn. 106° 12′.	R perf.
6 Spathic Iron, 251.	"	3·7—3·9.	Rbdn. 107°.	R perf.
7 Pyromorphite, 278.	"	6·5—7·1.	Hexag.	M ind.
8 *Margarite, 320. *Prim.*	3·5—4·5	3—3·1.	Hexag.	B perf.
9 Mesitine, 252.	4.	3·35–3·7.	Rbdn. 107° 14′.	R perf.
10 *Oligon Spar, 252.	"	3·7—3·8.	Rbdn. 107° 3′.	R perf.
11 *Nussierite, 279.	"	5—5·1.	Rbdn.	
12 Fluocerine, 258. *Prim*	"	4·7.	Hexag.	P.
13 Chabazite, 340. *Amyg. & prim.*	4—4·5.	2—2·22.	Rbdn. 94° 46′.	R ind.
14 *Beudantite, 522	"		Rbdn. 92° 30′.	a, perf
15 Pyrosmalite, 272. *Prim.*	"	2·95–3·1.	Rbdn, hexag prm.	a, em.
16 *Herschelite, 344 *Trap*	4·5.	2·11.	Hexag. table.	P. perf.
17 *Alum Stone, 232. *Volc.*	5.	2·6—2·8.	Rbdn. 92° 50′.	a, nearly perf.
18 Apatite, 237.	"	3—3·3.	Hexag.	Imp.
19 *Dioptase, 289.	"	3·278.	Rbdn. 126° 17′.	R.
20 Calamine, 263.	"	4·3—4·5.	Rbdn. 107° 40′.	R perf.
21 Willemite, 265 *Zinc ores*	5—5·5.	4—4·1.	Rbdn. 133°.	a, ind.
22 *Sil. of Cerium, 428.			Hexag.	
23 Troostite, 363. *Prim.*	5·5.	4—4·1.	Rbdn. 115°.	e perf
24 *Cerite, 428. *Prim*	"	4·912.	Hexag.	
25 *Nepheline, 317. *Volc*	5·5—6.	2·4–2·65.	Hexag.	Imp.
26 *Eudialyte, 416. *Prim*	6.	2·85-2·95	R. 73° 40′.	a, perf.
27 Quartz, 408.	7.	2·6—2·7.	Rbdn. 94° 15′.	Imp.
28 Tourmaline, 389. *Prim.*	7—8.	3—3·1.	Rbdn. 133° 26′.	Ind.
29 Beryl, 391. *Prim*	7·5—8	2·6—2·8.	Hexag. prms.	P ind
30 *Phenacite, 394. *Prim.*	"	2·9—3.	Rbdn. 115° 25′.	R.
31 Sapphire, 398 *Prim*	9.	3·9.	Rbdn. 86° 6′.	a, perf.

SECTION II. LUSTRE METALLIC.

Names of Species.	Hard	Sp. Grav.	Form, R R.	Cleavage.
Molybdenite, 560. *Prim.*	1—1·5.	4·5—4·8.	Hexag.	Fol!
2 Graphite, 519.	1—2.	2·0891.	Hexag.	Fol!
3 *Tetradymite, 501.	2.	7·5—7·6	Rbdn.	a, fol.
4 Native Tellurium, 465.	2—2·5.	5·7—6·1.	Hexag.	Imp.
5 Cinnabar, 507.	"	7·8—8·2.	Rbdn. 71° 47′.	*a* perf.
6 *Dark Red Silver, 506.	2·5.	5·7—5·9.	Rbdn. 108° 18′.	R imp.
7 Polybasite, 489.	2—3.	6·2—6·3.	Rbdn.	Ind.
8 Capillary Pyrites, 471.	about 3.	5·2—5·3.	Rbdn. 144° 8′.	R perf.
9 Zinkenite, 493. *Antim. ores.*	3—3·5.	5·3—5·4.	Hexag.	Ind.
10 Native Antimony, 466.	"	6·6—6·8.	Rbdn. 117° 15′.	a, perf! R dist.
11 Native Arsenic, 467.	3·5.	5·65—6.	Rbdn. 114° 26′.	a, imp.
12 Magnetic Pyrites, 476.	3·5—4·5.	4·6—4·7.	Hexag.	P perf.
13 Copper Nickel, 470	5—5·5.	7·3—7·7.	Hexag.	
14 Ilmenite, 454. *Prim.*	5—6.	4·4—5.	Rbdn. 85° 59′.	Ind.
15 *Antimonial Nickel, 469.	5·5—6.	7·5—7·6.	Hexag.	
16 Specular Iron, 450.	5·5—6·5.	5—5·3.	Rbdn. 85° 58′.	R and a, ind.
17 *Iridosmine, 459.	6—7.	19–21·5.	Hexag.	P.

Lustre.	Color, Diaphaneity, &c.
1 Vit—p'rly.	C. w; ywh, gyh, bn: Trp—op.
2 Pearly; splend.	C. and St. white.
3 Vit.. p'rly.	C. rose-r; bnh: St. w: Trl—sbtrl.
4 Vit—p'rly.	C. w; gnh, rdh, bnh: St. w—gy: Sbtrp—trl. Cryst. often wit. [curved fa
5 Vit.	C. w. gyh, rdh, bnh: St. w, bn: Trl—sbtrl.
6 Vit . . p'rly.	C. y, gy, ash-gy, bn, rdh: Darkens on exposure. Crystals often with curved faces.
7 Res.	C. gn, bn; ywh, rdh, gyh: St. w; ywh: Sbtrp—sbtrl.
8 P'p'rly.	C. pale pearl-gy, rdh-w, ywh: St. w: Trl—sbtrl.
9 Vit.	C. yw, rdh-bn: trl—op.
10 Vit.	C. ywh: Trl.
11 Greasy, feeble.	C. yw, gnh, gyh: St. ywh-w, gyh.
12	C. dark-b, r, ywh; deeper when wet: St. w, or ywh: Sbtrl—op.
13 Vit; splend.	C. w, rdh-w; ywh: St. w: Sbtrp—trl.
14 Res.	C. bk; in thin fragments, deep bn and trl: St. gnh-gy.
15 a, p'rly.	C. pale bn, gn, gy: St. paler: Trl—op.
16	C. w: Trl—op.
17 P'rly and Vit.	C. w; rdh, gyh: St. w: Trp—sbtrl.
18 Vit . . res	C. light gn, wh, bh: St. w: Trp—op: Brittle.
19 Vit . . res.	C. emerald-gn, bkh-gn: St. gn: Trp—trl.
20 Vit . p'rly.	C. w; gn, gyh, gnh, bnh: St. w: Sbtrp—trl.
21 Res.	C. yw, ywh and rdh-bn: St. w, ywh: Trl—op.
22	C. pale ywh-bn: Trl.
23 Vit . . res.	C. pale gn, y, gy, r, bn: St. w: Trp—trl: Brittle.
24 Ad.	C. clove-bn, cherry-r: St. gyh-w: Sbtrl—op: Splintery.
25 Vit . . prly, grsy.	C. w, ywh, gnh, bh, gyh, bnh, brick-red: St. w: Trp—op.
26 Vit.	C. bnh-r, rose-r: St. w: Sbtrl—op.
27 Vit.	C. various: St. w, gyh: Trp—trl—op. Crystals mostly hexagonal prisms terminated by pyramids.
28 Vit.	C. b, bk, bn, gn, r; often bright: St. w: Crystals mostly prisms.
29 Vit.	C. gn; bh, ywh, w: St. w: Trp—sbtrl—op.
30 Vit.	C. w, wine-yw, rdh: St. w: Trp—op: Fr. like that of quartz.
31 Vit.	C. b, r, gn, yw, bn, gy, w: St. w: Trp—trl.

SECTION II. LUSTRE METALLIC.

1 Met.	C. and St. lead-gy: Soils paper—trace on porcelain gnh: Lam. flex
2 Met.	C. iron-bk, dark steel-gy. St. bk; shining: Sectile. Soils paper. Trace same as color.
3 Met.	C. pale steel-gy: Soils paper. Lam. elastic. Not very sectile.
4 Met.	C. and St. tin-white: Brittle.
5 Submet—ad.	C. lead-gy—cochineal-red: St. scarlet: Sbtrp—sbtrl.
6 Met-ad.	C. iron-black . . cochineal-red: St. coch-red: Op. Sectile.
7 Met., splend.	C. iron-bk: St. bk: Sectile.
8 Met.	C. brass-yw . . bronze-yw, and steel-gy: Brittle.
9 Met.	C. and St. steel-gy.
10 Met.	C. and St. tin-w: Not ductile.
11 Met.	C. and St. tin-w; tarnish soon to dark-gy: Brittle.
12 Met.	C. bronze-yw, copper-r: St. dark gyh-bk: Tarnish: Slightly attracted [by magnet.
13 Met.	C. Copper-r: St. pale bnh-bk: Brittle.
14 Met.	C. dark iron-bk: St. bk: Brittle: Slight action on the needle.
15 Met., splend.	C. light copper-r; . . violet: St. rdh-bn: Not mag: Brittle.
16 Met.	C. dark steel-gy—iron-bk: St. cherry-r, rdh-bn: Often irisedly tarnished
17 Met.	C. tin-w, pale steel-gy: St. similar: Brittle.

CLASSIFICATION II., INDEPENDENT OF CRYSTALLIZATION.

The following are the subdivisions adopted in this system of classification. Particular explanations are given in a subsequent page.

CLASS I.

G. under 3·8. Solid individuals, having an acid, alkaline, or saline taste.

SECTION 1. FLUIDS.

Includes the gases and liquids. As these species are few in numbe , and are associated together on pages 211, 212, and 213, in the Descriptive part of the Treatise, a tabular arrangement is not given below.

SECTION 2. SOLIDS.

Subsection A. Easily soluble.
a. Taste like that of alum. Color white, or grayish. No effervescence with acids.
b. Taste alkaline. Color white, or grayish. Effervescence with acids.
c. Taste sweetish-alkaline; rather feeble.
d. Taste purely saline.
e. Taste saline and bitter. Color white, or with a slight tinge of blue or green.

CLASS I.

SECTION II. SOLIDS.

Subsection A. Easily soluble.

a. *Taste* like that of alum. *Color* white, or grayish. No effervescence with acids.

Names of Species	*Hardness.*	*Sp. Grav.*	*Structure.*	*Lustre.*
1 Soda Alum, 216.	2—3.	1·88.	Fib., pulv., mas.	P'rly, vit.
2 Potash Alum, 216.	2—2·5.	1·75.	I: Effl.	Vit, p'rly.
3 *Ammonia Alum, 217.			I: Fib.	Resinous.
4 Magnesia Alum, 216.			Fib; mas.	Shining.
5 Feather Alum, 215.	2—3.		I: Fib, crusts.	Vit, silky.
6 Iron Alum, 217.			Fib, or plumose.	Silky.
7 Manganese Alum, 217.			Fib.	Silky.

b. *Taste* alkaline. *Color* white, or yellowish. Effervescence with acids.

1 Natron, 218.	1—1·5.	1·4—1·5.	IV: Effl, fol, mas.	Vit.
2 *Gay-Lussite, 218.	2—3.	1·9—2.	IV: Fol.	Vit.
3 Trona, 219.	2·5—3.	2·1—2·15.	IV: Fib; mas.	Vit.

c. *Taste* sweetish-alkaline.

1 *Borax, 215.	2—2·5.	1·7–1·75.	IV: mas.

f. Taste saline and cooling. Color white. Deflagrates on burning coals. Effervesces with heated sulphuric acid.
g. Taste astringent, metallic. Often deeply colored. No effervescence with acids.
Subsection B. Solubility inconsiderable.

CLASS II.

G. above 1·8. Tasteless.

SECTION 1. LUSTRE UNMETALLIC.

Subsection A. Streak white, or grayish-white.
Subsection B. Streak colored.*

SECTION 2. LUSTRE METALLIC.

CLASS III.

G. under 1·8. Includes resinous and carbonaceous minerals. These species are not included in the table, for the same reason as the Fluids. They are described on pages 512—520.

* A few of the species present, in their different varieties, sometimes a white, and in others a colored streak, and consequently may be found in each of these subsections.

CLASS I.

SECTION II. SOLIDS.

Subsection A. Easily soluble.

Taste like that of alum. *Color* white, or grayish. No effervescence with acids.

	Color, Diaphaneity, &c.	*Blowpipe.*
1	C. w: Sbtrp—sbtrl: Sol. ½ weight of water at 60°.	Fus!, int.
2	C. w: Trp—trl: Sol. 16 times weight of cold water.	Fus !, int.
3	C. and St. gyh-w: Trp—trl.	
4	C. and St. snow-w.	
5	C. w; ywh, rdh: Sbtrl—sbtrp.	Fus !, int.
6	C. ywh-w: T. sweetish-astringent.	Loses water and becomes red.
7		

b. *Taste* alkaline. *Color* white, or yellowish. Effervescence with acids.

1	C. w, gyh, ywh: Efflorescent.	Fus !
2	C. w, gnh, ywh: Trp—trl. Not efflorescent. Partially soluble.	Dec, fus !
3	C. w, ywh, gyh: Not effl. or deliq: Easily soluble.	Dec, fus !

c. *Taste* sweetish-alkaline.

1	C. w, gyh, gnh: Trp—trl: Effl. slowly.	Int, fus. trp. vit. glob

d. *Taste* purely saline.

Names of Species.	*Hardness*	*Sp. Grav*	*Structure.*	*Lustre.*
1 Common Salt, 219.	2.	2·2—2·3.	I: Fol, mas; fib.	Vit.

e. *Taste* saline and bitter. *Color* white, or with a slight tinge of blue or green.

1 *Glauber's Salt, 220.	1·5—2.	1·4—1·5.	IV: Effl. crusts.	Vit.
2 *Sal Ammoniac, 222. *V. &c.*	"	1·5—1·6.	I: Imit, crusts, effl.	Vit.
3 *Mascagnine, 222. *Volc.*	"		III: Mas, pulv.	Vit.
4 *Thenardite, 221.	2—2·5.	2·7—2·8.	III: Crusts.	Vit.
5 *Aphthitalite, 222. *Volc*	2·1—3.	1·7—1·8.	Mam, mas.	Vit.
6 *Epsom Salt, 221.	2—2·5.	"	III: Fib, Imit, effl	Vit, p'rly.
7 Nitrate of Lime, 223.		1·62.	Cryst. effl. silken tufts.	
8 Nitrate of Magnesia, 223.		1·74.	Effl.	

f. *Taste* saline and cooling. *Color* white. Deflagrates on burning coals.

1 Nitrate of Soda, 223.	1·5—2.	2—3.	VI: Effl., gran.	Vit.
2 Nitre, 224.	1.	1·9—2.	III: Fib, crust.	Vit.

g. *Taste* astringent, metallic. Often deeply colored. No effervescence with acids.

1 Copperas, 224.	2.	1·8—1·9.	IV: Imit; pulv.	Vit.
2 *Botryogen, 227.	2—2·5.	2—2·1.	IV: Imit, mas.	Vit.
3 White Vitriol, 226.	"	"	III: Effl. crusts.	Vit.
4 Coquimbite, 225.	"	"	VI: Mas.	
5 *Yellow Copperas, 225.			VI.	P'rly.
6 *Cobalt Vitriol, 227.			IV: Imit: crusts.	Vit, p'rly.
7 *Blue Vitriol, 226.	2·5.	2·2—2·3.	V: Mas.	Vit.
8 *Johannite, 227.	"	3·1—3·2.	IV: Agg. cryst.	Vit.

Subsection B. Solubility inconsiderable. *Taste* weak.

1 *Sassolin, 214. *Volc.*		1·4—1·5.	VI: cryst. grains; Imit.	P'rly.
2 *Arsenous Acid, 214.	1·5.	3·698.	I: Imit.	Vit.. silky.
3 *Glauberite, 228.	2·5—3.	2·75-2·85	IV.	Vit.
4 Polyhalite, 228.	"	2·7—2·8.	III: Fib. mas.	Res, p'rly.

d. *Taste* purely saline.

Color, Diaphaneity, &c.	*Blowpipe.*
1 C. w, gyh, bh, rdh, violet: Effervesce with sulphuric acid.	Decrep.

e. *Taste* saline and bitter. *Color* white, or with a slight tinge of blue or green.

1 C. w, gyh: Trp—op: T. cool, then feebly saline and bitter: Efflor. No effervescence with acids.	Watery fusion.
2 C. w, ywh, gyh, gnh: Trp—trl: T. acute and pungent: Not deliquescent: Ef. sul.	Vol. w. fumes.
3 C. ywh, gyh-w: Sbtrp—trl: T. pungent, bitter: Slowly del: No ef.	Decomp. at red heat.
4 C. w: T. saline and bitter: No ef. with acids.	Fuses at red heat.
5 C. w, bh, gnh: Trl: T. pungent, saline, bitter: Ef. sul.	1.
6 C. w: Trl: T. bitter, saline.	Del; fus. dif.
7 C. w, gy: Very deliquescent.	Watery, fus., slight det.
8 C. w: deliquescent.	Watery, fus., scarcely det.

f. *Taste* saline and cooling. *Color* white. Deflagrates on burning coals.

1 C. w, rdh, bnh, ywh: Trp—trl: T. more bitter than Nitre: Deliquescent: Ef. hot sul.	Defl. with deep yw. light.
2 C. w: Trp—trl: Not deliquescent or efflorescent: Ef. hot sul.	Deflagrates.

g. *Taste* astringent, metallic. Often deeply colored. No effervescence with acids.

1 C. gn; wh; yw on exposure: St. w: Sbtrp—trl: T. sweetish astringent and metallic.	*Bor*, gn-glass.
2 C. hyacinth-r, ochre-yw: St. yw, shining: T. slightly astringent.	Becomes mag.
3 C. w: Trl: T. astringent, nauseous, metallic: Very soluble.	Int.
4 C. w; tinge of violet: T. sweetish astringent: Hot sol. precips. ox. [iron.	
5 C. yw: Trl.	
6 C. flesh-r, rose-r: Sbtrp—trl: T. astringent.	*Bor*, b.
7 C. sky-b: St. w: Sbtrp—trl: T. metallic and nauseous.	2·5.
8 C. gn. St. ywh-gn: Sbtrp—op: T. bitter, somewhat astringent.	

Subsection B. Solubility inconsiderable. *Taste* weak.

1 C. gyh, ywh-w: Feel smooth and unctuous: T. acidulous, and slightly saline and bitter.	Fus. in candle; flame gn.
2 C. w, ywh, rdh: St. w: T. sweetish astringent.	On char. vol; alliac. odor.
3 C. ywh, gyh-w: St. w: Sbtrp—trl: Loses trp. in water.	Dec.
4 C. gy—brick-red; ywh: Trl—op: Taste saline and bitter weak.	Fus.: In candle, op, bnh.

CLASS II.

SECTION I. LUSTRE UNMETALLIC.

Subsection A. *Streak* white, or grayish-white.

Names of Species.	*Hardness.*	*Sp. Grav.*	*Structure.*	*Lustre.*
1 *P[illegible]ite, 304.	1.		Mas. like soap.	Res.
2 *Saponite, 316.	"		Mas; very soft.	Greasy.
3 *Cimolite, 303.	1—1·5.	2·1—2·2.	Mas. earthy.	Weak.
4 *Nontronite, 303.			Like clay.	Unctuous.
5 Talc, 315. *Prim., amyg.*	"	2·7—2·9.	III: fol! mas.	P'rly; earthy.
6 Pyrophyllite, 318.	"		Fol! coarse gran.	Pearly.
7 Horn Silver, 299.	"	5·5—5·6.	I: Crusts; mas.	Waxy; . . ad.
8 *Iodic Silver, 300.	"		Fol-mas.	Res.
9 *Pissophane, 232.	1·5.	1·9—2.	Mas.	Vit.
10 Chlorite, 317.	"	2·6—2·9.	Fol; gran.	Vit, p'rly.
11 Carb. Silver, 298.	"		Mas. incrust.	Weak or earthy.
12 *Bromic Silver, 300.			I: In concretions.	
13 Hydro-magnesite, 250. *Serpentine.*	1—2.	2·8–2·81.	Pulv. crusts.	Dull.
14 *Horn Quicksilver, 300.	"	6·4—6·5.	II: Mas, coatings, gn.	Ad.
15 *Bismuth Ochre, 263. *Prim*	"	4·3—4·4.	Earthy, mas, pulv.	Dull, earthy.
16 *Scarbroite, 302. *G-wacke.*		1·4—1·5.	Mas.	Dull.
17 *Kollyrite, 301.	1—3.		Like Clay.	Vit.
18 *Websterite, 231. *Clay.*	1·5—2.	1·6—1·7.	Ren, mas.	Dull, earthy.
19 *Halloylite, 301.		1·8—2·1.	Mas.	Waxy.
20 Sea Foam, 308.	"		Mas.	
21 *Hydrous Mica, 324. *Prim.*	"		Fol!	Pearly.
22 Borate of Lime, 243.			IV: Fib.	Vit; sil[illegible].
23 *Oxalate of iron, 230.		2·1—2·5.	Earthy.	Dull.
24 Brucite, 314.	1·5—2.	2·3—2·4.	VI: Fol!	P'rly.
25 Gypsum, 210.	1·75—2.	2·25-2·35	IV: fol:. Lam, stel, fib, mas.	P'rly, vit.
26 *Hydroboracite, 242.	2.	1·9.	Fib, fol.	
27 Iron Sinter, 268.	"	2·2—2·4.	Ren, mas.	Vit; greasy.
28 Nemalite,† 313. *Serpentine.*	"	2·3—2·5.	Slender fib.	P'rly.

† Nemalite, Picrosmine, Picrolite, (a variety of Serpentine,) and Asbestus, (a variety silky, or like flax, and often differing little in hardness. They may be distinguished by and fibrous gypsum, may also be confounded with them; but the former is harder and and crumbles at once in the blowpipe flame, but does not fuse at any temperature.

CLASS II.

SECTION I. LUSTRE UNMETALLIC.

Subsection A. *Streak* white, or grayish-white.

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe*
1 C. siskin and oil-gn: St. lighter.		
2 C. w, ywh, bh, rdh: Almost like butter.	*Sul.* sol.	6: Blackns.
3 C. w, gyh.	No action.	7.
4 C. straw-yw, gnh: Op.	*Mur.* acts; in part [gelat.	7: Becomes red.
5 C. gn, gnh-w, w: Sbtrp—trl: Feel soapy: Sectile: Lam. flexible, not elastic.		6: Loses color.
6 C. apple-gn, w, gyh-gn, bnh-yw, ochre-yw: Sbtrp—sbtrl.		7: Swells up!!
7 C. pearl-gy, bh, gnh; on exposure bnh: St. shining: Trl—sbtrl: Sectile.	Insol. *nit.*	Fus. in candles, mur. fumes.
8 C. w, ywh-gn; on exposure bh: St. submet: Lam. flex: Silvery-w if polished.		On char. fus!!, violet fumes.
9 C. dull green: Trp: Fragile.	Sol. *mur.*	7: Blackens.
10 C. dark-gn.	*Sul.* decomp.	6.
11 C. ash-gray, black.	*Mur.* ef.	1·5: Silver on char.
12 C. green, yw.		
13 C. and St. w: Op: Adheres to the tongue.	*Nit.* ef.	7.
14 C. ywh-gy; ywh, gyh-w: Trl—sbtrl: Sect.		On char. volatilized.
15 C. gnh-yw, straw-yw, gyh-w.	*Nit.* sol.	On char. met.; vol.
16 C. pure-w: Odor argil.: Polished by nail: Absorbs water if immersed in it; transparency not increased.		
17 C. w: Trl—op: Fr. earthy: Splits into col. masses like starch, when calcined.	*Nit.* sol., no ef.	Unalt; evolves water.
18 C. white: Op: Fr. earthy: Adheres to the tonge: Feel meagre.	Sol., no ef.	7.
19 C. w, bh: Sbtrl: Adheres to tongue: More trp. in water.	*Sul.*, gel!	7: Milk-w.
20 C. gyh-w, rdh: Feel unctuous: Absorbs water, forms paste without plasticity.		7: Whitens.
21 C. bk, ruby-red: Lam. not elastic.	*Mur.*, partly decom	Evolves water.
22 C. colorless or white: Fibrous var. odorous.		Expands to a paste in warm water.
23 C. yw: Op.	*Nit.* sol., no ef. ywh.	Bkns. in candle; vegeta. odor; easily decomp.
24 C. w, gnh, gyh, bh: Trl—sbtrl: Lam. flex.	Sol., no ef.	7: Whns; friable.
25 C. w, bh, rh, yh, gyh: Trp—trl: Lam. flex.; inelastic.	No action.	1·5: Wh'ns! Exf. friable.
26 C. w, with red spots: Thin plates trl: Like fib. and fol. gypsum.		Fus. easily, clear glass, flame gn.
27 C. ywh and rdh-bn, [illegible]: St. yw, w: Trl—op.		2: Arsen. fumes.
28 C. gyh, bh-w, ywh: Trl—sbtrl: Fibres separable: White and brittle on exposure.	Sol. *nit.*, no ef.	Op, friable in candle.

of Pyroxene or Hornblende,) are fibrous minerals; sometimes so delicately so, as to be the characters given under the several species. Fibrous carbonate of lime or satin spar, effervesces with the acids, and the latter is softer than either of the above, and whitens

Names of Species.	*Hardness.*	*Sp. Grav.*	*Structure.*	*Lustre.*
1 *Haidingerite, 240. *Prim.*	1·5—2·5.	2·8—2·9.	III: Fol: Bot.	Vit.
2 *Cotunnite, 275. *Volc.*	Soft.	1·8—1·9.	Acic. cryst.	Ad; . . p'rly.
3 *Mellite, 231. *Coal.*	2—2·5.	1·5—1·6.	II: Mas.	Res . . vit.
4 Kerolite, 311. *Serpentine.*	"	2—2·2.	Ren, glob; struct. lam: Crusts. [mas.	Res, vit.
5 *Pharmacolite, 239.	"	2·6—2·8.	IV: fol: Stel, fib, bot,	P'rly and vit.
6 Pinite, 304. *Prim.*	"	2·7—2·8	VI: Hex. prisms; fol.	Res . . pearly,
7 Agalmatolite, 307.		2·8—2·9.	Mas.	Dull. [weak.
8 Common Mica, 320. *Prim.*	"	2·8—3.	IV: Fol!: Fol-mas.	P'rly, vit, ad.
9 H[illegible]gonal Mica, 322. *Prim. Vesuv.*	"	2·8—3.	VI: Fol!: Fol-mas.	P'rly.
10 Zinc Bloom, 264	"	3·5—3·6.	Earthy incrust.	Dull.
11 *Leadhillite, 276. *Lead ores.*	"	6·2—6·5.	IV: cleav: Mas.	P'rly, res . . ad.
12 *Dioxylite, 276. *Lead ores.*	"	6·8—7.	IV, fol: Col; mas.	P'rly, ad . . res.
13 *Pennine, 318. *Prim*	2—3.		Fol! mas.	Vit, p'rly, sub-met.
14 Chrysocolla, 288. *Copper ores.*	"	2—2·4.	Bot, mas.	Vit, earthy.
15 *Pyrargillite, 302.			Mas; four-sided pms.	Shining, dull.
16 *Rosite, 302.	2·5.	2·7—2·8.	Mas; in grains.	"
17 Lithia Mica, 323. *Prim.*	"	2·85—3.	Fol! coarse gran.	Pearly.
18 Hyd. Anthophyllite, 312.	"	2·91.	Fib, col, diverg.	Silky.
19 *Oxalate of Lime, 230.	2·5—3.		IV.	Pearly.
20 Lepidomelane, 322.	"	3.	Fol!	Ad . . vit.
21 *Chenocoprolite, 269. *Prim.*	2—3.		Mammillary.	Res, shining.
22 *Cryolite, 231. *Prim.*	2—2·5.	2·9—3.	III: fol: Mas.	Vit . . p'rly.
23 Picrosmine, 312. *Prim.*	2·5—3.	2·5—2·7.	III: cleav; fib, mas.	P'rly vit.
24 *Hopeite, 266.	"	2·7—2·8.	III: cleav.	Vit. and p'rly.
25 Bromlite, 255.	"	3·7—3·75.	III; cleav; ind.	Vit.
26 White Antimony, 261. *Ant'y ores.*	"	5—5·6.	III: cleav: Mas.	Ad. p'rly.
27 Anglesite, 277. *Lead ores.*	"	6·25—6·3.	III: lam: Mas.	Ad . . vit, res.
28 *Cerasite, 275. *Lead ores.*	"	7—7·1.	III: Col; rad.	P'rly, ad.
29 Corneous Lead, 275. *Lead ores.*	2·75—3.	6—6·1.	II: Mas.	Ad.
30 Vanadinite, 281. *Lead ores.*	"	6·6—7·25.	VI: Glob, crusts, mas.	Res.
31 Molybdate of Lead, 280. *Lead ores.*	"	6·[illegible]—6·8.	II: crys. often tab: Mas.	Res.
32 Tungstate of Lead, 282. *Lead ores.*	"	7·9—8·1.	II: Mas.	Res.
33 *Allophane, 303.	3.	1·8—1·9.	Ren, mas.	Vit . . fract. splend.
34 Fahlunite, 305.	"	2·6—2·8.	VI: Hex. pms; fol!	Res. vit.
35 Ch[illegible]llite, 306.	1·5—4.	2·7—2·8.	VI: Hex. pms fol!	P'rly, vit.
36 R[illegible]73.	"		III, fol.	Vit.
37 Calcareous Spar, 243.	[illegible]—3·5.	2·5—2·8.	VI[illegible] cl!: fib. imit, mas.	Vit. p'rly.
36 Anhydrite, 241.	2·75—3·5.	2·8—3.	III: fol: Lam, fib, mas.	P'rly, vit.

Color, Diaphaneity, &c.	Acids.	Blowpipe.
1 C. w: Trp—trl: Lam. slightly flexible.	Sol. *nit.*, no ef.	
2 C. w.		1 : B. flame : on char. [w fumes.
3 C. honey-yw, rdh, bnh : Trp—trl : Sectile.	Decomp. by boiling [water.	Wh'ns in candle : not [burn.
4 C. w, gn, bn : Trp—trl : Not adhere to tonge : Odor argil. : Feel soapy.		7.
5 C. w, gyh, ywh, rdh : Trl—op.	*Nit.* sol., no ef.	Fus. w fumes, arsen. odor.
6 C. gy, gyh-gn, bn : Op.		3·5 : Whitens.
7 C. w, gy, gn, yw, r, bn ; none bright : Sbtrl : Feel greasy : Sectile.	*Sul.* partly sol.	7 : Whitens.
8 C. various ; often bright : Trp—sbtrl : Lam. elastic ! tough. Presents two axes of polarization.		5·7—7 : Op.
9 C. dark-gn, bn, nearly bk : Lam. elastic ! tough. Presents one axis of polarization.		5·7 : Op.
10 C. w, gyh, ywh : Op.		Abundant w fumes.
11 C. ywh-w ; pale gyh, gnh, ywh : Trp—trl.	*Nit.*, ef !, w precip.	Int, yw ; w on cooling ; easily reduced.
12 C. gnh-w, ywh-w ; gyh : Trp—trl : Lam. flexible.	*Nit.* sol., no ef.	Fus ; glob. w on cooling.
13 C. bn, bnh-r, olive-gn : Trp—trl.	*Mur.* sol.	Fus. on edges, ywh-w. enamel.
14 C. emerald and pistachio-gn ; . . sky blue ; bnh : Sbtrl.	*Nit.* sol., no ef.	7 : B'kns in outer flame.
15 C. bk, bh : Argil. odor.	*Nit.* sol.	Argil. odor.
16 C. faint rose-, bnh-r : Sbtrp : Fr. splintery or somewhat foliated.		Fus. on edges ; *Bor.* fus. intum.
17 C. rose-red, gy : Trp—trl : Lam. elastic.		Fus. gyh slag ; Fl. rdh.
18 C. w, gnh-yw, bh-gy : Op : Sectile.		7.
19 C. w : Very brittle.		
20 C. black : Lam. somewhat brittle.		Fus. bk. mag. enam.
21 C. yw, pale-gn.		Arsen. fumes ; fus, bkh mag. scoria, on char. silv.
22 C. w ; rh, ywh : Sbtrp—trl : More trp. in water : Feel greasy : Odor argillaceous.		Fus. in candle.
23 C. gnh-w, gnh-gy, leek-gn : Sbtrl. sectile.		7 ; evolves water ; op.
24 C. gyh-w ; rdh-bn : Trp—trl. Sectile.	*Nit.*, *mur.* sol ; no ef.	Fus. trp. glob., flame gn. *Soda*, zinc fumes.
25 C. snow-w : Trl.	*mur.* effer.	7 : *bor*, trp. glass.
26 C. w ; . . pale-r, ash-gy : Sbtrp—trl : Sect.		Fus. in candle : on char. vol, produces w. coat'g.
27 C. ywh-, gyh-, gnh-w ; yw, gy : Trp—trl.	Not sol. *nit.*	1·5 : Dec ; w. slag.
28 C. w, ywh-w, rdh : Trl—op : Brittle.		1 : on ch. mur. fumes.
29 C. w ; pale-gy, yw, greenish : Trp—trl.		1 : yw glob ; w. on cooling : On char. lead.
30 C. light-bnh-yw, straw-yw, rdh-bn : Sbtrl—op.	*Sul.*, gn sol. ; *nit.* yw.	Fus : on cool'g again yw.
31 C. wax-yw, or orange-yw, ywh-w : Sbtrp.—sbtrl.		1·5—2. Dec. ; darkens ; on char. lead.
32 C. gn, gy, bn, r : Trl—sbtrl.		1·5-2 ; ox. of lead on char.
33 C. pale-b ; gn, bn, yw : Trl : Very brittle.	Gelat. with acids.	7 : Lose color, intum ; gn flame.
34 C. gn, dark-bn, bk : Op : St. gyh-w.		5-6 : Gy ; *bor*! slow sol, colored globule.
35 C. gn, gnh-bn, gyh.		5 : *Soda*, eff, gnh glob.
36 C. deep rose-red : T[illegible]		Bkns ; evolves water ; *bor*. b. glob.
37 C. w ; gy, rh, gnh, ywh ; dark-bn, bk : Trp—sbtrl. Some varieties very soft and earthy.	Effervesce !	7 : W, Intense light.
38 C. w ; rh, bh, gyh : Trp—trl : Cleavages rectangular, distinct.	No ef.	4 : Evolves no moisture ; Whitens, not exf.

Names of Species.		Hardness.	Sp. Grav.	Structure.	Lustre.
1 Celestine, 254.		2·75–3·5	3·8—4.	III: Fib, lam, mas.	Vit, res.
2 Heavy Spar, 257.		"	4·3—4·8.	III: Fib. lam, mas.	Vit, p'rly, res.
3 Serpentine, 309.		2·5—3·5.	2·4—2·6.	III: Mas, fib, fol.	Res—earthy.
4 Sulphato-Carbonate of Baryta, 258.		2·75-3·25	4·141.	Hex. prisms with term. pyramids.	Vit.
5 Haydenite, 342, 526.		3.		IV: cleav.	Vit.
6 Fluellite, 234.		3.		III: rhc, oct.	
7 Mimetene, 279.	*Lead ores.*	2·75—3·5.	6·4—6·5.	VI: Imit: Mas.	Res.
8 Gibbsite, 304.		3—3·5.	2·4.	Stalac, small botryoid.	Faint.
9 [illegible]ite Lead, 274.		"	6·1—6·5.	III. Col; mas. gran.	Ad: res.
10 Witherite, 256.		3—3·75.	4·2—4·35.	III: Imit, col, mas.	Vit . . res.
11 *Gigantolite, 307.		2—3·5.	2·8—2·9.	Hexag. pms; fol!	Vit . . waxy, submet.
12 *Stellite, 336.	*Amyg.*	3—3·5.	2·612.	III: acic. rad.	Silky.
13 *Villarsite, 311.	*Dolomite.*	"	2·9—3.	III; rhc. oct.	
14 Mesole, 334.	*Amyg.*	3·5.	2·3—2·4.	III: cl: Col. lam, rad, crest-like aggreg; mas.	Silky, p'rly.
15 *Dreelite, 256.		"	3·2—3·4.	VI: cleav. in traces.	P'rly: Splen. on fract.
16 Diallogite, 253.		"	3·5—3·6.	VI: cleav: Bot. mas.	Vit, p'rly.
17 Strontianite, 253.		"	3·6–3·72	III: cleav: Fib, mas.	Res: . . vit.
18 Magnesite, 249.	*Serp.*	3—4.	2·9—3.	VI, cl; fib. mas.	Vit; silky.
19 Cacoxene, 233.		"	3·35—3·4.	In tufts, silky.	
20 Spathic Iron, 251.		"	3·7—3·9.	VI, cleav! fol. mas.	Vit, p'rly.
21 *Selenate of Lead, 280.		"		Spher, bot, fib.	Gre[illegible]—vit.
22 Wavellite, 233.		3·25—4.	2·3—2·4.	III: Delicately col-hemisph, stel, fib.	P'rly, vit.
23 Stilbite, 328.	*Amyg., prim.*	3·5—4.	2·1—2·2.	III; fol! Rad, div, sheaf-aggreg, glob; particles lam. or fib.	Vit; . . p'rly.
24 Heulandite, 324.	*Amyg., prim.*	"	2·15-2·25	IV: fol! mas.	P'rly and vit.
25 Laumonite, 326.	*Amyg. & prim.*	"	2·25-2·35	IV: Mas.	Vit . . p'rly.
26 *Pyrallolite, 308.	*Prim.*	"	2·5—2·6.	V: gran.	Dull; res.
27 Schiller Spar, 313.	*Serp.*	"	2·5—2·7.	V: fol! lam.	Met-p'rly, vit.
28 Dolomite, [illegible].		"	2·8—2·9.	VI: cleav: Imit; mas.	Vit; . . p'rly.
29 Ankerite, [illegible].		"	2·9—3·2.	Vi: Mas.	Vit . . p'rly.
30 Arragonite, 246.		"	2·8—3.	III: Col, fib, imit.	Vit . . res.
31 Scorodite. 269		"	3·1—3·2.	III: Mas.	Ad . . vit.
32 *Leucophane, 235.		"	2·9—3.		Vit.
33 [illegible]alcite, 255.		"	3·6—3·7.	IV: Mas.	Vit . . res.
34 [illegible]hane, 278.	*Prim.*	"	5·1—5·5.	VI: Mas.	Ad . . res.
35 Pyromorphite, 278.	*Lead ores.*	"	6·5—7·1.	VI: Glob, ren, bot, fib.	Res.
36 *Huraulite, 267.	*Gran.*	above 3.	2·27.	IV.	Vit.
37 *Killinite, 305.	*Prim.*	4.	2·6—2·8.	Cryst: mas.	Vit; weak.

Color, Diaphaneity, &c.	Acids.	Blowpipe.
1 C. w, bh, rh, flesh-red: Trp—sbtrl.	No ef.	3: Dec; op: phos.
2 C. w, ywh, gyh, bh, bnh, rh: Trp—sbtrl.	No ef.	1: Dec.
3 C. dark or light green to gnh, bh-w; none bright: Trl—op: Sect: Feel often soapy.		6: Hardens.
4 C. snow-w: Trl.		
5 C. bhn-yw, wine-yw: Trp—trl.		
6 C. w: Trp.		
7 C. pale yw; bnh, bnh-r: Sbtrp—trl.	Sol! in hot *nit.*	1: On ch. arsen; lead.
8 C. gnh-, gyh-w: Trl: Surface smooth.		7; Whitens: blue, with cobalt.
9 C. w, gyh, bnh: St. w, gyh: Trp—trl. Brittle.	*Nit.* sol. ef.	1: Dec; yw, r; met-lead.
10 C. w, ywh-w, orange-yw, gyh: Sbtrl—trl. Brittle.	Ef. *nit.*	2: Op. glob.
11 C. greenish . . dark steel-gy.		Fus: intum. gnh slag.
12 C. w: Trl.	*Mur.* gel.	Fus. ef. w. enam.
13 C. ywh-gn: Subtrp: Fr. granular.	Strong acid, sol.	7: *bor*, gn enam.
14 C. gyh-w, ywh: Trl: Lam. slightly clast.		2·5.
15 C. and St. w.		
16 C. rose-red; bnh: Trl—sbtrl.	Ef. *nit.*	7: Bn. or bk; dec. *Bor.* violet-b. glass.
17 C. light-gn, pale ywh-bn, yw, gy, w: St. w: Trp—trl.	Ef. *mur.* and *nit.*	5·5: colors flame rdh.
18 C. w, ywh, gyh, bn: Trp—op.	*Nit.* slow sol., little efferv.	7.
19 C. yw, ywh-bn;—bn, on exposure.		Bor. fus. red bead.
20 C. ywh-, ash-, gnh-gy; rdh: Darkens on exposure: Sbtrl.	Pulv., some ef. *nit.*	5: B'kns; mag; *Bor.* gn.
21 C. sulphur yw: Brittle.		Fus; odor of horse-radish, on charcoal.
22 C. w, gnh, bh, ywh, bnh: Trl.	Sol. hot *nit;* evol. vap's corro. glass.	7: Op.
23 C. w; yw, r, bn: St. w: Sbtrp—trl.	Gel. in *nit.* dif!	2·5: Intu. colorless glass.
24 C. w, r, gyh, bnh: Sbtrp—trl.	*Mur.* sol, not gel.	2—2·5: Intum.
25 C. w; ywh, gyh: St. w: Trl: Becomes white and friable on exposure.	Gelat.	2·75—3: w. frothy mass.
26 C. w; gnh: sbtrl-op: Fr. earthy.		bk. then w; intum., fus. on edges.
27 C. olive-gn, bkh-gn, pinchb'k bn: St. gyh-w . . ywh: Sbtrl. Lam. separable.		5: Darker bn, more met.
28 C. w; rdh, gnh, gy, bn, bk: Sbtrp—trl.	Ef.	7: sometimes darkens.
29 C. w; gyh, rdh, bnh: St. w—bn: Trl—sbtrl: darkens on exposure.	Some ef.	7: B'kns. infus. mag.
30 C. w, gy, yw, gnh, bh: St. gyh-w: Trp—trl. Brittle.	Ef. *nit.* and *mur.*	7: Decrep; phosph. on red hot iron.
31 C. leek-gn, gnh-w; bk-w, liver-bn: Sbtrp. —sbtrl.		2: rdh-bn. scoria; arsen. fumes.
32 C. pale dirty-gn, to wine-yw: Trp—trl.		Violet glass, col'less, cold.
33 C. w; gyh, ywh, [illegible]: Trp—trl.	Ef. in *nit.* or *mur.*	7: *Bor.* fus. [illegible] glass.
34 C. w, gyh-w: Trl.		W. friable mass. Flame gnh-b; on char. arsen.
35 C. gn, yw, bn; orange-yw: St. w, ywh: sbtrl—sbtrp: Brittle.	Sol. hot *nit.*	1·5; polyhedral glob.
36 C. rdh-yw: Trp.		2; Bk, met. button.
37 C. gnh-gy, bn: St. ywh-w: Trl—sbtrl.		Whitens; fus. w. enam.

	Names of Species.	Hardness.	Sp. Grav.	Structure.	Lustre.
1	Fluor Spar, 236.	4.	3·1–3·2	I, cleav!: Mas.	Vit.
2	Mesitine Spar, 252.	"	3·3–3·65.	VI, cleav: mas.	Vit.
3	*Oligon Spar, 252.	"	3·7–3·8	VI, cleav: mas.	Vit.
4	*Nussierite, 279. *Lead ores.*	"	5–5·1.	VI; rbdn: Mam.	Greasy.
5	*Margarite, 320. *Prim.*	3·5–4·5.	3–3·1.	VI, fol! gran.	P'rly, vit.
6	*Bismuth Blende, 263. *Prim.*	"	5·9–6·1.	I: Glob. col, mas.	Res . . ad.
7	Chabazite, 340. *Amyg., prim.*	4–4·5.	2–2·17.	VI: col. mas.	Vit; . . ad.
8	*Phillipsite, 332. *Prim. volc.*	"	2–2·2.	III: rad.	Vit.
9	Harmotome, 331. *Amyg. &c.*	"	2·3–2·5.	III: rarely mas.	Vit.
10	Epistilbite, 329. *Amyg., volc.*	"	2·2–2·3.	III, cleav! Mas.	Pearly . . vit
11	*Carphosiderite, 272.	"	2·5.	Reniform masses.	Res.
12	*Edingtonite, 330. *Amyg.*	"	2·7–2·8.	II; minute.	Vitreous.
13	*Pyrosmalite, 272. *Prim.*	"	3–3·1.	VI. Hexag: Mas.	Pearly.
14	*Fluocerine, 258. *Prim*	"	4·7.	VI: Mas.	Weak.
15	Tungst. of Lime, 260. *Prim*	"	6–6·1.	II: Ren, col, mas.	Vit . . ad.
16	*Plumbo-resinite, 285. *Lead ores.*	"	6·3–6·4.	Reniform.	Res.
17	*Bismutite, 262. *Bism*	"	6·8–7.	Acic., mas.	Vit; dull.
18	*Herschelite, 314. *Trap*	4–5.	2·11.	VI. hexag, cleav.	
19	*Thomsonite, 330. *Amyg*	4·5–5.	2·3–2·4	III, cl: fib, rad, mas.	Vit . . p'rly.
20	Tabular Spar, 361.	4–5.	2·7–2·9.	V: fib. lam.	Vit . . p'rly.
21	Beudantite, 522.	"		Rbdn, 92° 30'.	Res.
22	Clintonite, 311	"	3–3·1.	IV: fol!	Met-pearly.
23	Apophyllite, 327. *Volc. &c.*	4·5–5.	2·3–2·4.	II, fol!	P'rly and vit.
24	*Dysclasite, 335. *Amyg*	"	2·25–2·4.	Fib.	Somewhat p'rly.
25	*Turnerite, 374. *Prim.*	"		IV, Cryst. small.	Subad., splend
26	Pectolite, 334. *Amyg.*	"	2·69.	Glob. div, fibres.	Vit . . p'rly.
27	Apatite, 237.	"	3–3·3.	VI. Hexag: Col. mas.	Vit . . res.
28	Electric Calamine, 265.	"	3·2–3·5.	III, cl: Fib, bot, mas.	Vit . . p'rly, ad.
29	Yttrocerite, 259. *Prim.*	"	3·4–3·5.	III, cleav: Mas.	Vit, p'rly.
30	* Basic Fluocerine, 259.	5.		I: Massive.	Vit.
31	Natrolite, 332. *Volc., amyg.*	4·5–5·5.	2·1–2·3	III: Acic. Stel, mas.	Vitreous.
32	*Poonahlite, 333. *Amyg.*	"	2·16.	III. Slender prisms.	Vitreous.
33	*Carpholite, 375. *Gran.*	"	2·9–3.	Fib, rad, stel.	Silky.
34	*Alum Stone, 232. *Volc.*	"	2·6–2·8.	VI. Mas.	Vit . . pearly; earthy.
35	*Childrenite, 235.	"		III.	Vit . . res.
36	Humboldtilite, 359 *Volc.*	5.	2·9–3·2.	II; cleav.	Vit.
37	*Herderite, 231. *Prim.*	"	2·9–3.	III.	Vit . . res.
38	*Glaucolite, 346. *Prim.*	"	2·7–2·9.	Mas. imperf. cleav.	Vit.
39	*Triphyline, 269. *Prim.*	"	3·6.	III, cleav; mas.	Vit . . greasy.
40	*Phos. iron and mang., 267.	"	3·9–4.	Like apatite? mas.	Greasy.
41	Calamine, 263.	"	4·2–4·5.	VI: Bot; ren; mas.	Vit . . pearly.
42	Analcime, 337. *Amyg., volc.*	5–5·5.	2–2·3.	I: Gran, Mas.	Vit.
43	*Brewsterite, 325. *Amyg.*	"	2·1–2·45.	IV, Cleav!	Vit, pearly.
44	*Scolecite, 335. *Volc. amyg.*	"	2·2–2·3.	III: Div; Rad; mas.	Vit . . pearly.

Color, Diaphaneity, &c.	Acids.	Blowpipe.
1 C. w, yw, b, gn, r, often lively: Trp—trl.	*Sul.* fum. cor. glass.	3—3·5: Dec; phos!
2 C. ywh: Trl—sbtrl.	*Nit.* pulv. slow sol.	7.
3 C. yw, rdh-bn.	*Nit.* pulv. slow sol.	7: *Bor.* amethyst glob.
4 C. yw, gnh, gyh: St. ywh-w, gyh.	Sol. *nit.*, no ef.	Whitish enamel.
5 C. pearl-gy, rdh-w, ywh-w: Trl—sbtrl.		Intum; fus.
6 C. dark hair-brown, ywh-gy, straw-yw: St. ywh-gy.		1·5: dark yw: w. fum. char. ywh-gy.
7 C. w, rdh, ywh: Sbtrp—trl.		2·5: Spongy glass.
8 C. w; rdh: Trp—op.		3.
9 C. w; gy, yw, rh, bnh: Sbtrp—trl: Cryst. often crossed.	Hot acid acts slowly.	Phos, yw. light; on ch. fus, no intum.
10 C. w: Trp—sbtrl.	Sol. strong *mur;* exc't sil.	Froths, vesic. enam.
11 C. straw-yw: St. glimmering: Feel greasy.		Bk; fus. dif. mag: *Bor.* fus! bk.
12 C. gyh-w: Sbtrp—trl.		W, op; fus. dif. trp. glass.
13 C. pale liver-bn, gy, gn, gnh-w: St. paler.	Sol. *mur;* exc't sil.	Reddish-bn; mur. fum; fus. dif.
14 C. dark tile-r, ywh; deeper when wet: Sbtrl—op.		7: *Bor.* fus. dif; blood-r in outer flame while hot.
15 C. w, ywh, bnh, orange-yw: Sbtrp—op.	Yw. in *nit;* not sol.	5: Dec.
16 C. ywh, rh-bn, ywh-w; striped: Trl: Resembles gum arabic.		Dec; evolves water; inf. enam. on char.
17 C. green, dirty-gn, straw-yw, gyh: Sbtrl—op.	*Mur.* yw. sol.	1: Eff; met. glob; on coal white coating.
18 C. w: Trl—op: Cleav. perf. par. with P.		
19 C. w; bnh: Trp—trl: Brittle.	*Mur.* gel.	2—2·5: Int. snow w, op.
20 C. w, gyh-w, ywh, rh, bnh: Sbtrp—trl.		5: *Bor.* fus! trp.
21 C. bk: st. gnh-gy: sbtrl.		
22 C. rdh-bn: Sbtrl: Foliated struct. distinct.	Acted on by *nit.* & *mur.*	7: *Bor.* trp. pearl.
23 C. w, gyh; bh, gnh, rh: Trp—op.	*Nit.* subgelat.	2: Exf. int. w; *Bor.* fus.
24 C. w, ywh, bh: Sbtrp—sbtrl: Very tough.	*Mur.* gel!	3—3·5: Op; *Bor.* trp. glass.
25 C. yw; bn: Trp—trl.		
26 C. w; ywh, gyh: Op. Resembles mesotype.		Fus. trp. glass.
27 C. sea-gn, bh, wh, gy, rh, bn; none bright: Trp—op: Brittle.	*Nit.* sol. slowly; no ef.	5: *Bor.* fus!
28 C. w; b, gn, yw, bn: Trp—trl.	Gel. in hot *nit.* [yw.	6: Op. int. ph; *Bor.* fus.
29 C. violet-b, gy, w; rdh-bn: Op.	Pulv. sol. hot *mur.*	7: Whitens.
30 C. fine yw, rdh, bnh: St. yw: Sbtrl—op.	*Mur.* odorous fumes.	7: *Bor.* slowly a glob. blood-r, while hot.
31 C. w; ywh, gyh: St. gy: Trp—trl.	Gel!; also after being heated.	2: Op; glass; phos.
32 C. w: Trp—trl.		2·5.
33 C. straw-yw, wax-yw: Op: Very brittle.		4: Intum, *Bor.* trp. violet.
34 C. w; rh, gyh: Trp—sbtrl.	Sol. *Sul.*	7: Dec. pulv.
35 C. y, pale ywh-bn, ywh-w: St. w: Trl.		
36 C. y, ywh-gy, bn: Sbtrp.	Gelat. *nit.*	5: spongy, trp. glass.
37 C. ywh-, gnh-w: Trl: Very brittle.		
38 C. lavender-b; gnh: Sbtrl: Fr. splintery.		5: *Bor.* fus.
39 C. gnh-gy, bh: St. gyh-w: Trl—sbtrl.	Soluble.	2: gy, met bead. [mag.
40 C. clove-bn: St. gyh-w.		Dec: fus. bh-bk glass,
41 C. w, gyh, gnh, bnh, gn, bn: Sbtrp—trl.	*Nit.* ef.; not gel.	7: Op; w. flocks of oxyd of zinc.
42 C. w; rdh, gyh: Trp—op: Brittle.	Gel. *mur.*	2·5 Intum., glassy globule.
43 C. w; ywh, gyh: Trp—trl.	Sol.	3: Op. froths.
44 C. w: Trp—trl.	Gel! *nit.* and *mur.* before, but not after ignition.	2·5: Op, and curls! in outer flame.

Names of Species.	Hardness.	Sp. Grav.	Structure.	Lustre.
1 Datholite, 342. *Amyg., prim.*	5.	2—9 3	IV: Fib. bot, mas.	Vitreous.
2 Anthophyllite, 372. *Prim.*	"	2·9—3·2.	IV, Cl: Col, fib-mas; Lam.	Pearly.
3 *Wagnerite, 234.	"	3—3·2.	IV.	Vit.
4 Sphene, 421. *Prim.*	"	3·2—3·5	IV: Lam, Mas.	Ad .. resin.
5 Triplite, 266. *Granite.*	"	3·4—3·8.	Lam, Mas.	Res .. ad.
6 *Willemite, 265. *Calamine.*	"	4—4·1.	VI: Ren; Mas.	Resinous.
7 *Yttro-Columbite, 435. *Prim*	"	5·3—5·9.	Lam: grains.	Submet; vit.
8 Troostite, 363. *Prim.*	5·5.	4—4·1.	VI: Mas.	Vit; .. res.
9 *Cerite, 428. *Prim.*	"	4·8—5.	Mas.	Ad.
10 *Magnesian Pharmacolite, 239.	5—6.	2·5—2·6.	Massive, foliated.	Waxy.
11 Scapolite, 357. *Prim.*	"	2·6—2·8.	II: mas; Col; lam.	Vit; p'rly.
12 Perovskite, 424. *Prim.*	5·5.	4·01—4·1.	I. Cube.	Met.-ad.
13 Boltonite, 345. *Prim. limest.*	5—6.	2·8—2·9.	Cleav; mas; gran.	Vit.
14 Hornblende, 368. *Prim., volc.*	"	2·9—3·4.	IV: Rad, col, fib, mas.	Vit .. p'rly.
15 Lazulite, 347.	"	3—3·1.	III: Mas.	Vit.
16 Pyroxene, 364. *Prim., volc., basalt.*	"	3·2—3·4.	IV, cleav: mas, fib.	Vit .. res, p'rly
17 *Sodalite, 338.	5·5—6.	2·2-2·43.	I: Mas.	Vit.
18 *Leucite, 338. *Volc.*	"	2·4—2·5.	I, Trapezohedrons; Mas.	Vit. not strong
19 *Nepheline, 347.	"	2·4—2·6.	VI; hexagonal: mas.	Vit; greasy.
20 *Lapis Lazuli, 339.	"	2·5—2·9.	I, Dodec: mas.	Vit.
21 *Gehlenite, 359. *Prim limest., volc.*	"	2·9—3·1.	II: in crystals.	
22 *Romeine, 262. *Prim.*	"		II; minute cryst.	
23 Acmite, 373. *Prim.*	"	3·2—3·4.	IV, long pointed cryst.	Vit .. res.
24 Allanite, 429. *Prim.*	"	3·3—3·8.	IV: Mas; acic.	Vit, submet.
25 Saussurite, 345.	"	3·2—3·4.	Massive, cleav.	P'rly .. vit, res.
26 Babingtonite, 368. *Granite.* [*Dolom.*	"	3·4—3·5.	V.	Vit. splend.
27 *Periclase, 405. *Vesuv.*	"	3·75.	Cubic.	Vit.
28 *Anatase, 423. *Prim.*	"	3·8—3·9.	II. In crystals.	Met.-ad; res.
29 Feldspar, 348. *Prim.*	6.	2·35—2·6.	IV, cleav: Mas.	P'rly; vit.
30 *Ryacolite, 351. *Volc.*	"	2·5—2·7.	IV; in glassy cryst.	Vit—p'rly.
31 Albite, 352. *Prim.*	"	2·6—2·7.	V, cleav: Lam, gran.	P'rly, vit.
32 *Anorthite, 354. *Volc.*	"	2·65—2·8.	V: Coarse col., lam.	P'rly .. vit.
33 *Oligoclase, 355. *Prim.*	"	2·6—2·7.	V; cleav.	Vit, ply, greasy
34 Labradorite, 355. *Prim.*	"	2·65—2·8.	V, cleav: Mas.	P'rly .. vit.
35 *Hauyne, 339.	"	2·7—3·3.	Dodec.	Vit.
36 *Andesin, 353.	"	2·74.	V; cleav. mas.	Vit .. p'rly.
37 *Eudialyte, 416. *Prim.*	"	2·85-2·95	VI, cleav: Mas.	Vitreous.
38 *Turquois, 346.	"	2·8—3.	Reniform; no cleav.	Waxy, dull.
39 *Amblygonite, 374. *Granite.*	"	3—3·1.	IV: Mas. and col.	Vit. and p'rly.
40 *Heterozite, 267.	about 6.	3·35-3·55	IV, cleav: Mas.	Res.
41 Opal, 414.	5·5—6·5.	2—2·3.	Mas, imitative.	Vit .. res.

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe.*
1 C. w; gnh, ywh, gyh, rdh: Trl—sbtrl.	Gel! *nit.*	2: Friable in candle.
2 C. ywh-gy, bnh-gn, clove-bn: Trl—subtrl.		6: *Bor.* fus. dif; grass-gn.
3 C. orange-yw; gyh: Trl.	Hot *Sul.* evolves Fluoric acid.	1: Dark gnh-gy glass. *Bor.* fus. easily.
4 C. bn, yw, gy, gn; not lively: Sbtrl—op.	*Nit.* sol. exc't sil.	4: *Bor.* ywh-gn glass.
5 C. bkh-bn: St. ywh-gy.	*Nit.* sol., no ef.	1·5: Bk. scoria.
6 C. w; ywh, rdh-bn: Trp—op.	*Mur.* or *nit.* gel.	6: Flame gn; *Bor.* fus.
7 C. bk, bn, yw, gnh: St. gyh-w.		7: Dec., lighter colored.
8 C. pale gn, yw, gy, rdh-bn; none bright: Trp—trl.	Sol. *mur.* odor chlorine.	5: Trp.
9 C. clove-bn . . cherry-r; gyh: Sbtrp—op: St. gyh-w: Brittle.		7: *Bor.* yw. while hot.
10 C. dirty-w, honey-yw: Brittle.		W. arsenical fumes.
11 C. w; gyh-bk, gnh, rh: Trp—sbtrl.		3: Int., vesic. glass.
12 C. gyh to iron-bk: St. gyh-w: op.		7: *Bor.* clear glass.
13 C. bh-gy, ywh-gy, gyh-w, often yw. on exposure.		7: W, trp: *Bor.* trp. glass.
14 C. gn. of various shades, w, bn, bk, and intermediate shades: Sbtrp—op. Some fibrous varieties, like cotton or flax, and soft.		3·5—6: Glob. not clear. *Bor.* fus.
15 C. pure blue, gnh-b: St. w: Sbtrp—op.		3: *Bor.* clear globule.
16 C. gn, bnh, gyh, wh, bkh: Trp—op. Some fibrous varieties resembling those of hornblende.		3·5—4: Glassy globule.
17 C. gyh, bn, b: Trp—sbtrl.	*Nit.* gel.	3: Colorless glass.
18 C. w, ywh, gyh; gy: Sbtrp—trl.	Powder greens the blue of violets.	7: *Bor.* fus. dif: *cobalt* blue.
19 C. w, ywh, gyh, gnh, bnh, rdh: Trp—op.	*Nit.* nebulous; gel.	4.
20 C. rich blue: Trl—op.	Loses color if calcined.	3: Trl, or op. glass.
21 C. gy; gyh, ywh; not bright: Op—sbtrl.	Heated *mur.* gel.	5·5: *Bor.* slowly.
22 C. hyacinth or honey-yw.		
23 C. bn, rdh-bn, bkh-gn: St. pale gnh-, or ywh-gy: Op.	No action.	2: Bk. globule.
24 C. pitch-bn: St. gy, gnh-gy.		Fus. bk. glob.
25 C. w; . . mountain-gn, gnh-gy, ash-gy.	No action.	Fus. dif! white glass.
26 C. dark gnh-bk, bnh: Sbtrl—op.		3: Bk. enamel: *Bor.* violet.
27 C. light gnh: Trl.	Sol. no. ef.	Infusible.
28 C. bn, indigo-b: Sbtrp—trl.		7: Loses col; *Bor.* fus. dif.
29 C. wh, gy, gnh, bh, rh, r: Trp—sbtrl.	No action.	5: *Bor.* trp. glass. [yw.
30 C. gyh-yw, w, colorless: Trp.		4: *Bor.* trp. glass; flame
31 C. w; gyh, rh, gnh, bh: Trp—sbtrl.	No action.	4·5: On ch. glassy.
32 C. w: Trp—trl. Crystals never twins.	Strong *mur.* decom.	4.
33 C. ywh, gnh-w, w: Trp—sbtrl.	No action.	5.
34 C. gy, bn, rdh-bn, gnh; play of colors. Sbtrl.	Hot *mur.* decom.	3: Colorless glass.
35 C. bright-b, gnh: Trp.	*Mur.* gel.	Fus. slowly, op.
36 C. w, gyh: Trl—sbtrl.		5: Pulv. blebby slag.
37 C. bnh-r, rose-r: Op—sbtrl.	Pulv. gelat.	2·5—3: Leek-gn scoria.
38 C. bh-gn: Sbtrp—op.	No action.	7: Colors flame green. *Bor.* fus.
39 C. pale mountain-, sea-gn: Sbtrp—trl.		On char. fus! trp; op. on cooling.
40 C. gnh-gy, bh: violet after exposure, and lustre submetallic.	Sol. exc't Silica.	Fus. bn. submet. globule.
41 C. w, yw, r, bn, gn, gy; pale; play of col- in some specimens: Trp—sbtrl.		7: Dec., opaque.

Names of species.	*Hardness.*	*Sp. Grav.*	*Structure*	*Lustre.*
1 *Latrobite, 356. *Prim.*	5·5—6·5.	2·7—2·8.	V: massive.	
2 Chondrodite, 388. *Prim. limest.*	"	3·1—3·2.	IV: Gran. mas.	Vit, res.
3 Manganese Spar, 362. *Prim.*	5·5—7.	3·4—3·7.	V: Mas.	Vit.
4 Petalite, 360. *Prim.*	6—6·5.	2·4—2·5.	Cleav. mas,—col, gran.	Vit.. resinous, p'rly.
5 *Couzeranite, 356.	"	2·69.	Cryst; mas.	Vit.
6 *Bustamite, 363.	"	3·1—3·3.	Rad, lam, ren, bot, mas.	
7 Cummingtonite, 373. *Prim.*	"	"	Thin col, div. stel.	Pearly.
8 *Helvin, 385. *Prim.*	"	"	I, Cryst. hemihed.	Vit .. res.
9 *Diaspore, 377. *Prim.*	"	3·4—3·5.	V, cleav: Lam. prisms.	Vit; pearly, splend.
10 *Ligurite, 404. *Talc. rock.*		3·45–3·5.	IV.	Vit., res.
11 *Ostranite, 418. *Prim.*	6·5.	4·3—4·4.	III: cryst.	Vit.
12 Kyanite, 375. *Prim.*	5—7.	3·5—3·7	V: coarse col.	P'rly; vit.
13 *Anthosiderite, 446.	6·5.	about 3.	Fib, tufts.	
14 Idocrase, 381. *Volc., prim.*	"	3·3—3·4.	II: Mas.	Vit;.. res.
15 Obsidian, 415. *Volc.*	6—7.	2·2—2·4.	Mas.	Vit; p'rly; res.
16 Prehnite, 343. *Amyg., prim.*	"	2·8—3.	III: Bot, Mas.	Vit.
17 Bucholzite, 378. *Prim.*	"	3·19–3·6.	Columnar, fib.	P'rly, glistn'g.
18 Epidote, 379. *Prim.*	"	3·2—3·5.	IV: Gran, mas; fib.	Vit. p'rly.
19 Tin Ore, 427. *Prim.*	"	6·5—7·1.	II: Mas., fib.	Ad., res.
20 Spodumene, 360. *Prim.*	6·5—7.	3·1—3·2.	Coarse fol, gran.	Pearly.
21 *Humite, 389. *Vesuv.*	"	"	III: Minute cryst.	Vit.
22 Axinite, 407. *Prim.*	"	3·2—3·3.	V: Cryst. flat and acute.	Vit, splend.
23 Chrysolite, 403. *Volc., basalt.*	"	3·3–3·55.	III: Glob. mas.	Vit.
24 *Tautolite, 404. *Volc. feld-spar.*	"	3·8—3·9.	III.	Vit.
25 Nephrite, 344.	6·5—7·5.	2·9—3·1.	Mas.	Vit.
26 Andalusite, 386. *Prim.*	"	2·9—3·2.	III: Imperf. col., gran.	Vit;.. p'rly.
27 Garnet, 382. *Prim., volc.*	"	3·5—4·3.	I: Gran. mas.	Vit; res.
28 Quartz, 408.	7.	2·6—2·8.	VI: Mas.	Vit, res
29 *Boracite, 405. *Gypsum.*	"	2·9—3.	I: Small crystals.	Vit .. ad.
30 *Rhodizite, 406.			I: Small crystals.	Vit .. ad.
31 Iolite, 406. *Prim.*	"	2·5–2·75.	III: Mas.	Vit.
32 *Wörthite, 376.	7·25.	above 3.	Foliated mas.	P'rly .. vit.
33 Sillimanite, 377. *Prim.*	7—7·5.	3·2—3·4	V: Cryst. long; div.	Vit .. p'rly.
34 Staurotide, 385. *Prim.*	"	3·5—3·8.	III: Crystals.	Vit .. res.
35 Tourmaline, 389. *Prim.*	7—8.	3—3·1.	VI: Col, mas.	Vit.
36 Euclase, 393. *Prim.*	7·5.	2·9—3·1.	IV: In crystals.	Vit.
37 Pyrope, 384.	"	3·6—3·8.	I: Rounded grains.	Vit.
38 Zircon, 417. *Volc., prim., &c.*	"	4·45—4·8.	II: Gran., seldom mas.	Subadamantine.
39 Beryl, 391. *Prim.*	7·5—8.	2·6—2·8.	VI: Coarse col, gran.	Vit, res.
40 *Sapphirine, 399.	"	3·4—3·5.	In cleav. grains.	Vit, splend.
41 *Forsterite, 403. *Vesuvius.*	"		III: Cleav.	Vit, splend.

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe.*
1 C. pale red, or pink.		W. enamel. *Bor.* pale amethyst in outer flame.
2 C. light-yw, bn, r; apple-gn: St. w; ywh: Trp—sbtrl. Very brittle.		6! *Bor.* fus! ywh-gn.
3 C. flesh-r, bnh, gnh, ywh: Trp—sbtrl: Bn. on exposure.		3: Bkh. glass.
4 C. w—bh, rh, gnh: Trl: Brittle.		3·5: Gentle heat blue phos. *Bor.* trp. glass.
5 C. gy, gnh; bk.	No action.	W. enamel.
6 C. light-gy; gnh, rh: Sbtrl—op.		3.
7 C. ash-gy: Trl—op: Fibres rather incoherent.		Fus. dif!! *Soda* cf. bk. glass.
8 C. wax-yw, ywh-bn, siskin-gn: Sbtrl.		3: On char. fus. with eff.
9 C. gnh-gy, hair-bn: Sbtrl—trl.		Decrep. violently. *Bor.* colorless glass.
10 C. apple-gn; sometimes speckled: Trp—trl.		
11 C. clove-bn, smoke-gy: St. lighter. Very brittle.	*Nit.* insol.	7: Paler; *Bor.* dif.
12 C. b; gy, w; central line of crystals often blue, and the edges w: Trp—sbtrl.		7: *Bor.* fus. dif. trp.
13 C. ochre-bn, gyh: Op—sbtrl.		
14 C. deep-bn, leek-gn, olive-gn, colorless: Trp—sbtrl.		2·5: Trl. yw, or gnh. glob.
15 C. bk, bn, gy, w; none bright: Trl—sbtrl.		Fus. vesic. glass.
16 C. leek-gn, bh, gyh, w: Trl—sbtrl: Tough.	*Mur.* sol. not gel.	2·5: Whitens; *Bor.* fus. dif.
17 C. w, gy, ywh: Trl—sbtrl: Brittle.		7.
18 C. dark gn, ywh-gn, bh, gy, bn, rdh.		3—3·5: *Bor.* dif. trp.
19 C. bn, bk, w, gy, yw, r: Sbtrp—op.		7: *Bor.* on char. tin.
20 C. gyh-w, gyh-gn, gnh-w: Trl—sbtrl.	No action.	3·5—4: Op. intum. exf; uncolored glass.
21 C. yw, w, rdh-bn: Trp—trl.		7: Op; *Bor.* trp. glass.
22 C. clove-bn;.. plum-b, pearl-gy: Trp-sbtrl.		2: Int, dark gn. glass.
23 C. grass-, olive-gn, ywh, bnh: Trp—trl.		7: Darkened; *Bor.* trp. glass.
24 C. velvet-bk: Op.		Fus. bkh. scoria., mag: *Bor.* clear gn. glass.
25 C. leek-gn; bh, rdh, gyh, wh: Trl—sbtrl.		7: Wh'ns; *Bor.* clear gl's
26 C. pearl-gy, flesh-r: Tough: Some Chiastolite varieties soft.		7: *Bor.* fus. dif. trp. gl's.
27 C. r, bn, yw, w, gn, bk: Trp—trl.		
28 C. w; violet-b, rose-r, bn, gn, yw, r: Trp—op.		3: No efferv. bk. glob.
29 C. w, gyh, ywh, gnh: Sbtrp—trl.		7: *Soda* fus! ef. trp glass
30 C. gyh or ywh-w: Trl: Pyroelectric.	*Mur.* sol. dif.	2·5: Intum; fus. w glass.
31 C. b, bnh, ywh, ywh-gy: Trp—trl.		Subfus; flame gn.
32 C. w: Trl.		5—5·5: B, trp. glass.
33 C. hair-bn, gyh: Trl—sbtrl: Brittle.		Gives out water: Co-balt, b!
34 C. bnh-red, bnh-bk; dark and not bright: Sbtrp—op.		7: *Bor.* inf.
		7.
35 C. bk, bn, gn, dark-b, r, w: Light colors transparent, dark, opaque.		2·5: Intum. Elect. by heat.
36 C. mountain-gn, b, w, always pale: Trp—sbtrp.		5·5: Intum. in strong heat.
37 C. blood-r: Trp—Trl.		4: *Bor.* bright gn.
38 C. r, bn, yw, gy, gn, w; none bright except some red tints: Trp—trl.		7: *Bor.* clear glass.
39 C. gn; bh, yh; pale except emerald-gn: Trp—sbtrl.		5·5: *Bor.* trp. glass.
40 C. pale sapphire-blue: Trp—sbtrl.		
41 C. [illegible]less: Translucent.		7: *Bor.* infus.

Names of Species.		Hardness.	Sp. Grav.	Structure.	Lustre.
1 Topaz, 401.	*Prim.*	7·5—8.	3·4—3·6.	III: Cleav: Col; mas.	Vit.
2 Automolite, 397.	*Prim.*	"	4·2—4·3.	I: Oct. cryst.	Vit . . res.
3 Dysluite, 397.	*Prim.*	"	4·5—4·6.	I: Oct. cryst.	Vit . . res.
4 *Phenacite, 394.	*Prim.*	8.	2·9—3.	VI: Rhombohedral.	Vit.
5 Spinel, 395.	*Prim.*	"	3·5—3·6.	I: Oct. cryst.	Vit.
6 Chrysoberyl, 394.	*Prim.*	8·5.	3·5—3·8.	III: Cryst.	Vit.
7 Sapphire, 398.	*Prim.*	9.	3·9—4·2.	VI: Mas.	Vit— . . p'rly.
8 Diamond, 399.		10.	3·4—3·65	I.	Vit, ad.

ARRANGEMENT OF THE MINERAL SPECIES IN CLASS II, SECTION I, SUBSECTION A, ACCORDING TO THEIR SPECIFIC GRAVITIES.

Scarbroite,	1·4—1·5.	Apophyllite,	2·3—2·5.	Hopeite,	2·7—2·9.
Mellite,	1·5—1·6.	Thomsonite,	"	Pinite,	"
Websterite,	1·5—2.	Nemalite,	"	Edingtonite,	"
Cotunnite,	1·8—1·9.	Feldspar,	2·3—2·6.	Amphodelite,	"
Allophane,	"	Gibbsite,	2·4.	Tabular Spar,	"
Halloylite,	1·8—2·1.	Leucite,	2·4—2·5.	Osmelite,	"
Hydroboracite,	1·9.	Petalite,	"	Glaucolite,	"
Pissophane,	1·9—2.	Serpentine,	2·4—2·6.	Hydromagnesite,	2·8—2·81.
Gmelinite,	2—2·1.	Nepheline,	"	Haidingerite,	2·8—2·9.
Chabazite,	2—2·2.	Carphosiderite,	2·5.	Agalmatolite,	"
Kerolite,	"	Pyrallolite,	2·5—2·6.	Gigantolite,	"
Phillipsite,	"	Mag. Pharmacolite,	"	Dolomite,	"
Opal,	2—2·3.	Picrosmine,	2·5—2·7.	Boltonite,	"
Analcime,	"	Iolite,	2·5—2·75.	Common Mica,	2·8—3
Chrysocolla,	2—2·4.	Calc Spar,	2·5—2·8.	Lithia Mica,	"
Herschelite,	2·11.	Ryacolite,	2·5—2·7.	Hexagonal Mica,	"
Cimolite,	2·1—2·2.	Schiller Spar,	"	Anhydrite,	"
Stilbite,	2·1—2.	Stellite,	2·6—2·65.	Magnesite,	"
Poohnahlite,	2·1—2·2.	Albite,	2·6—2·7.	Arragonite,	"
Natrolite,	2·1—2·3.	Oligoclase,	"	Eudialyte,	"
Heulandite,	2·15—2·25.	Couzeranite,	"	Turquois,	"
Levyne,	2·198.	Pectolite,	"	Prehnite,	"
Brewsterite,	2·1—2·45.	Lapis-Lazuli,	2·5—2·9.	Cryolite,	2·9—3.
Oxalate of Iron,	2·1—2·5.	Killinite,	2·6—2·8.	Hydrous Anthophyllite,	"
Scolecite,	2·2—2·3	Fahlunite,	"	Carpholite,	"
Epistilbite,	"	Quartz,	"	Herderite,	"
Huraulite,	"	Scapolite,	"	Datholite,	"
Gypsum,	2·2—2·4.	Pharmacolite,	"	Boracite,	"
Iron Sinter,	"	Alum Stone,	"	Villarsite,	"
Sodalite,	"	Beryl,	"	Leucophane,	"
Obsidian,	"	Labradorite,	2·65—2·8.	Phenacite,	"
Dysclasite,	2·25—2·4.	Anorthite,	"	Gehlenite,	2·9—3·1.
Brucite,	2·3—2·4.	Andesin,	2·7—2·8.	Lepidomelane,	"
Laumonite,	2·25—2·35.	Latrobite,	"	Nephrite,	"
Mesole,	2·3—2·4.	Talc,	2·7—2·9.	Euclase,	"
Wavellite,	"	Chlorite,	"	Anthophyllite,	2·9—3·2.
Harmotome,	2·3—2·5.	Rosite,	"	Ankerite,	

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe.*
1 C. yw, gn, b, w; pale: Trl—sbtrl.		7: *Bor.* [illegible] trp. glass.
2 C. dirty-gn, bk, b: Sbtl—op.		7: *Soda* imperfect fusion; if re-fused, ox. zinc on charcoal.
3 C. ywh-bn, gyh-bn: Sbtl—op.		7: Red while hot; *Bor.* fus. dif! red.
4 Colorless; bright wine-yw, rdh: Trp—op.		7: *Bor.* trp. glass.
5 C. r, bh, gnh, yh, bn, bk: Trp—sbtrl: Some impure crystals, soft.		7: *Bor.* fus. dif.
6 C. gn; grass-gn, olive-gn, ywh, gyh: Trp—trl.		7: *Bor.* fus. dif!
7 C. b, r, gn, yw, bn, gy, w: Trp—trl.		7: *Bor.* fus. dif.
8 C. w, b, r, v, gn, bn, gy, bk: Trp–trl–sbtr.		

Humboldtilite.	2·9—3·2.	Diamond,	3·4—3·6	White Lead,	6·1—6·5.
Andalusite,	"	Manganese Spar,	3·4—3·7.	Leadhillite,	6·2—6·5.
Hauyne,	2·7—3·3.	Triplite,	3·4—3·8.	Plumbo-resinite,	6·3—6·4.
Margarite,	3—3·1.	Diallogite,	3·5—3·6.	Anglesite,	6·2—6·3.
Pyrosmalite,	"	Zinc Bloom,	"	Horn Quicksilver,	6·4—6·5.
Clintonite,	"	Spinel,	"	Mimetene,	"
Lazulite,	"	Kyanite,	3·5—3·7.	Tin Ore,	6·5—7·1.
Amblygonite,	"	Chrysoberyl,	3·5—3·8.	Molybd. of Lead,	6·7—6·8.
Tourmaline,	"	Staurotide,	"	Dioxylite,	6·8—7.
Rhomb Spar,	3—3·15.	Barytocalcite,	3·6—3·7.	Vanadinite,	6·6—7·25.
Wagnerite,	3—3·2.	Periclase,	3·7—3·8.	Bismutite,	6·8—7.
Apatite,	3—3·3.	Garnet,	3·8—4·3.	Cerasite,	7—7·1.
Hornblende,	2·9—3·4.	Triphyline,	3·6.	Tungstate of Lead,	7·9—8·1.
Fluor Spar,	3·1—3·2.	Strontianite,	3·6—3·8.		
Chondrodite,	"	Pyrope,	"	*Species in this sub-section*	
Spodumene,	"	Spathic Iron,	3·7—3·9.	*whose specific gravity has*	
Humite,	"	Tautolite,	3·8—3·9.	*not been determined.*	
Scorodite,	3·1—3·3.	Anatase,	"		
Bustamite,	"	Celestine,	3·8—4.	Borate of Lime.	
Cummingtonite,	"	Phos. Iron and Mang.,	3·9—4.	Bromic Silver.	
Helvine,	"	Sapphire,	3·9—4·2.	Carb. Silver.	
Axinite,	3·2—3·3.	Willemite,	4—4·1.	Chenocoprolite.	
Dreelite,	3·2—3·4.	Troostite,	"	Childrenite.	
Pyroxene,	"	Perovskite,	"	Fluellite.	
Acmite,	"	Sulph-carb. Baryta,	4·1—4·2.	Forsterite.	
Saussurite,	"	Witherite,	4·2—4·35.	Hydrous Mica.	
Sillimanite,	"	Automolite,	4·2—4·3.	Iodic Silver.	
Sphene,	3·2—3·5.	Calamine,	4·2—4·5.	Kollyrite.	
Epidote,	3·2—3·9.	Bismuth Ochre,	4·3—4·4.	Nontronite.	
Electric Calamine,	"	Ostranite,	"	Oxalate of Lime.	
Bucholzite,	3·2—3·6.	Heavy Spar,	4·3—4·8.	Pennine.	
Idocrase,	3·3—3·45.	Dysluite,	4·5—4·6.	Pinguite.	
Cacoxene,	3·35—3·4.	Zircon,	4·45—4·8.	Pyrargillite.	
Arfwedsonite,	3·3—3·55.	Fluocerine,	4·7.	Pyrophyllite.	
Chrysolite,	"	Cerite,	4·8—5.	Saponite.	
Heterozite,	3·35—3·55.	Yttro-Columbite,	5·3—5·4.	[illegible] Foam.	
Yttrocerite,	3·4—3·5.	Hedyphane,	5·4—5·5.	Selenate of Lead.	
Babingtonite,	"	Horn Silver,	5·5—5·6.	Rhodizite.	
Diaspore,	"	White Antimony,	"	Romeine.	
Sapphirine,	"	Bismuth Blende,	5·9—6·1.	Roselite.	
Ligurite,	3·15—3·5.	Corneous Lead,	6—6·1.	Turnerite.	
Topaz,	3·4—3·6.	Tungstate of Lime,	"	Worthite.	

Subsection B. *Streak colored.*

Names of Species	*Hardness*	*Sp. Gr.*	*Structure*	*Lustre*
1 Wad, 444	0.5	3.7	Ren, bot, coatings	Dull, earthy
2 *Copper Froth, 294 *Cop ores*	1—1.5	3—3.1	III Cleav Ren bot, col	P'rly, vit
3 *Red Antimony, 505 *Antimony ores*	"	4.4—4.6	IV Tufts, capil div	Ad—met
4 Tungstic Acid, 261 *Tungsten*			Mas pulv	Earthy
5 Earthy Cobalt 443		2.24	Bot earthy	Subresinous
6 Nickel Green, 296 *White nickel*			Capillary cryst; pulv	
7 Uranic Ochre, 296			Massive earthy	
8 *Cupreous Manganese 441	1.5	3.1—3.3	Ren bot, mas	Res
9 Plumbic Ochre, 285 *Lead ores volc*			Mas	Dull
10 Bismuth Ochre, 263		4.3—4.4	Mas, pulv, earthy	Ad, dull
11 *Green Iron Ore 271			Fib, rad	Silky, weak
12 *Alluaudite 271			Fib ren	Dull
13 *Melanchlor 271			Earthy in crust	Dull
14 *Arseniate of Cobalt 274				
15 *Bromic Silver 300			I Concretions	
16 *Velvet Copper Ore 296			Velvet druses	
17 *Beaumontite 2[illegible]			Like clay	Dull
18 *Mysorin 287 *Cop ores*		2.62	Massive	
19 *Nontronite 303	Soft		Mas like clay	Unctuous
20 *Pinguite, 304	Soft		Mas like soap	Res
21 Black Copper 4[illegible]			Coatings bot	Dull shining
22 Minium 285 *Lead ores*		4.6	Mas pulv	
23 *Hisingerite, 116 *Calc spar*		3—3.1	Cleav mas gran	
24 *Cobalt Bloom, 273	1.5—2	2.9—3	IV, fol' Stel fib, earthy coatings	Pearly—ad earthy
25 Vivianite, 270	"	2.6—2.7	IV, fol' imit, mas	P'rl, met, vit
26 *Orpiment, 509	"	3.4—3.5	III, fol Imit, mas	P'rly—met res
27 *Realgar, 508	"	3.4—3.7	IV Mas	Res
28 *Copper Mica, 293 *Cop ores*	2	2.5—2.6	VI, fol' Mas	P'rly vit, ad
29 Iron Sinter, 268	"	2.2—2.4	Ren, mas	Vit, greasy
30 *Anglarite, 271			Fib, rad	Vit
31 *Condurrite, 294 *Cop ores*	Soft	5.2	Compact or earthy	
32 *Aurichalcite, 287 *Cop ores*	2		Acic druses gran	Pearly
33 *Blue Copper, 486 *Gray-wacke*	about 2	3.8—3.82	Spher, surf cryst	Res, weak
34 Sulphur, 510 *Volc, &c*	1.5—2.5	2—2.1	III Mas	Res
35 *Liroconite, 291 *Cop ores*	2—2.5	2.1—3	III Mas	Vit, [illegible]
36 Uranite, 297	"	3.0—3.6	II, fol! Gran	P'rly [illegible]ad
37 *Miargyrite, [illegible]	"	5.2—5.3	IV	Submet[illegible], ad

Subsection B. *Streak* colored.

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe.*
1 C. and St. bn, bk: Op: Fract. earthy: Soils: Feels light on account of its porosity.		React. mang.
2 C. pale apple-gn, . . sky-b: St. paler: Trl—sbtrl.		Dec! flame gn: blackens, steel-gy., pearl.
3 C. cherry-r: St. bnh-r: Sbtrl.	*Nit.* w coating.	1: On ch; volatilized.
4 C. lemon-yw.		Greenish.
5 C. bh-bk, bnh-bk: Op: Sectile: St. shining.		*Bor.* blue; arsen.
6 C. apple-gn, gyh, w: St. gnh-w.		Darkens; on ch. arsen.
7 C. sulphur-yw; bnh, rdh; gently heated. orange-yw.	Efferv., yw. sol.	7: Green.
8 C. and St. bh-bn: Op.		7: Bn; *Bor.* violet and gn
9 C. between sulphur and lemon-yw: St. paler.		1: Reduced to met. lead.
10 C. gnh and straw-yw, gyh-w.		
11 C. dull leek-gn, on exposure yw, bn: Sbtrl.		Fus! bk. slag.
12 C. dull gn, bnh.		
13 C. black.		
14 C. carmine or rose-red.		Fus; arsen. fumes.
15 C. green, yw.		
16 C. fine smalt b.		
17 C. light blue, gn.		
18 C. bkh-bn, gnh, rdh.	Ef. *nit.*	
19 C. ywh, gnh: Op: Polished by friction.	*Mur.* in part gel.	7: Becomes red.
20 C. siskin and oil-gn: St. lighter.		
21 C. bk, bnh-bk: St. bk: Soils.		7: *Bor.* gn slag.
22 C. bright red.		Fus. globule of lead.
23 C. bk: St. gnh-gy, bnh-yw: Cross fract. earthy.		Low heat, mag; higher fus. bk: *Bor.* ywh-gn.
24 C. crimson and peach blossom-r, pearl-gy, gnh: St. paler: Dry powder deep lavender-b. Lam. flex.		1·5—2: Dkns; on char. ars: *Bor.* fine blue.
25 C. pale bkh-gn, indigo-b: St. bh-w, b: Lam. flex. Powder of dry mineral crushed, liver-bn. Sometimes earthy.	*Nit.* or *sul.* sol.	1·5: Dec; loses color; dark bn. scoria, magnetic.
26 C. lemon-yw: St. paler: Sbtrp—sbtrl: Sect: Lam. flex.	Sol. in acids.	1: Fumes of sulph. and arsen.
27 C. bright aurora-r: St. orange-yw, r: Sectile.		1: On char, burns b. flame, alliaceous odor.
28 C. emerald-gn, grass-gn: St. paler: Trp trl: Sectile.		Op, arsen; bk. glob.
29 C. ywh and rdh-bn, red, w: St. ywh-w: Trl—op.		2: Arsen fumes; rdh-bn scoria.
30 C. bh-gn, b, bnh-bk, bn: St. lighter than color: Trl—op.		Fus. bk. glob.
31 C. bnh-bk; bh.		Fus: arsen. fumes.
32 C. verdigris-gn: Trl.		Slag; *Bor.* gn glass.
33 C. indigo-b: St. lead-gy; shining: Sect.		Yields copper.
34 C. and St. sulphur-yw, rdh, gnh: Trp—sbtrl.	No action.	Burns at low temp. b. flame.
35 C. sky-b—verdigris-gn: St. paler: Sbtrp	*Nit.* sol., no ef.	Loses color and trpncy; arsenical fumes.
36 C. emerald and grass-gn; apple-gn, bright-yw: St. paler: Trp—sbtrp.	*Nit.* sol., no ef.	[illegible]: Op. yw; bk. glob. [antimony.
37 C. [illegible]n-bk: St. dark cherry-r: Sbtrl—op.	Dilute *nit.* sol.	[illegible]: Fumes of sul. and

Names of Species.	Hardness.	Sp. Grav.	Structure.	Lustre.
1 *Light Red Silver, 507.	2—2·5.	5·4—5·6.	VI: Mas.	Ad.
2 Cinnabar, 507.	"	8—8·1.	VI, cleav: Mas.	Ad . . met.
3 *Sideroschisolite, 447.	2—3.	3—3·4.	Cryst; mas.	Splend; earthy
4 *Cronstedtite, 446.	2·5.	3·3—3·4.	VI, fol!: Col, ren, mas.	Vit, bril.
5 *Dark Red Silver, 506.	"	5·7—5·9.	VI: Mas.	Met-ad.
6 *Vanadinite, 281. *Lead ores.*	2·75.	6·6—7·3.	VI: glob. concret.	Res.
7 Cube Ore, 268.	2·5—3.	3.	I: Mas.	Subadamant.
8 *Aphanesite, 290.	"	4·1—4·2.	IV; cleav!: Div.	P'rly.
9 *Atacamite, 293. *Volc., &c.*	"	4·1—4·5.	III, cleav: Mas, in grains.	Ad . . vit.
10 *Cuprous Anglesite, 284. *Lead ores.*	"	5·3—5·5.	IV, cleav!	Vit, ad.
11 Vauquelinite, 283. *Lead ores.*	"		IV: Mas, ren,	Ad, faint.
12 *Melanochroite, 283. *Lead ores.*	"	5·7—5·8.	III: Massive.	Res, glim.
13 *Chromate of Lead, 282.	"	6—6·1.	IV. Columnar, mas.	Ad.
14 *Caledonite, 284. *Lead ores.*	"	6·4.	III: Divergent.	Res.
15 *Pyrorthite, 430. *Granite.*	3.	2·1—2·3.	Long thin imbed. cryst.	Res, weak.
16 Olivenite, 292.	"	4·1—4·3.	III. Col. div, fib, imit, mas.	Ad . . vit, and p'rly.
17 *Huraulite, 267.	above 3.	2·25—2·3.	IV, in small cryst.	Vit.
18 *Volborthite, 295.	"		Aggreg. globules.	Vit.
19 Greenockite, 505. *Trap.*	3—3·5.	4·8—5.	Hexag.	Adamantine.
20 *Chloropal, 447.	3—4.	1·7—2·1.	Massive.	Earthy.
21 Cacoxene, 233. *Brown iron ore.*	"	3·3—3·4.	Div. fibres.	Silky.
22 *Pyrargillite, 302. *Granite.*	3—5.	2·5.	Mas.	Shining.
23 Ankerite, 249.	3·5—4.	2·9—3·2.	VI: Mas.	Vit . . p'rly.
24 *Brochantite, 295. *Cop. ores.*	"	3·7—3·8.	III.	Vit.
25 *Manganblende, 503.	"	3·9—4·1.	I: mas, gran.	Submet.
26 Green Malachite, 286. *Cop. ores.*	"	4—4·1.	IV: Fib, bot, mas, coatings.	Vit . . ad, silky, earthy.
27 Blende, 503.	"	4·0—4·1.	I, cleav: Fib, mas.	Ad; res—submet.
28 Red Copper Ore, 425.	"	5·9—6.	I: Fib, mas.	Ad., sub-met.
29 Pyromorphite, 278.		6·8—7·1.	VI: Imit, mas.	Res.
30 *Euchroite, 289. *Prim.*	3·5-4·25.	3·3—3·4.	III. cleav.	Vit.
31 Azurite, 286.	"	3·5—3·9.	IV: Bot, fib, mas.	Vit, ad.
32 *Bismuth Blende, 263.	"	5·9—6·1.	I: Glob, col, mas.	Res, ad.
33 *Mosandrite, 432.	4.	2·9—3.	Prism.: Mas, fib.	Vit, res.
34 *Crocidolite, 445.	"	3·2—3·3.	Fib; fibres separable, mas.	
35 *Libethenite, 292.	"	3·6—3·8.	III.	Res.
36 *Carphosiderite,	1—1·5.	2·5.	Reniform, mas.	Res.

Color, Diaphaneity, &c.	Acids.	Blowpipe.
1 C. cochineal-r: St. cochineal-r—aurora-r: Sbtrp—sbtrl.		1·5: sul. and arsenical fumes.
2 C. cochineal-r—bnh-r, lead-gy: St. scarlet-r, bnh: Sbtrp—sbtrl.	*Nit.* sol. r. fumes.	Wholly volatilized.
3 C. velvet-bk; dark gnh-gy: St. gnh: Op.	*Mur.* gel.	Bk. mag; ochre-red.
4 C. bnh-bk: St. dark leek-gn: Op: Lam. elastic.	Pulv. gel! *mur.*	Froths a little, not fus.
5 C. iron-bk—lead-gy: St. cochineal-r: Sectile: Trl—op.		1·5: Dec; fus, bh, flame; sulph.
6 C. light yw, rdh-bn: St. w; ywh: Sbtrl—op.	*Sul.* gn sol. *Nit.* yw sol.	Fus. and remains yw. on char, lead.
7 C. olive-gn, ywh-bn, bkh, grass-gn: St. pale olive-gn—bn: Sbtrl.		2: Int. no fumes; r. powder: On ch. ars. fumes.
8 C. dark verdigris-gn—sky-b: St. verdigris-gn: Sbtrl.		Def. fus! arsen. fumes.
9 C. olive-, grass-gn, bkh-gn: St. apple-gn: Trl—sbtrl.		2·5: Flame b. and gn; muriatic fumes.
10 C. fine azure-b: St. pale-b: Trl—sbtrl.		Indicates cop. and lead.
11 C. bkh-, olive-gn: St. siskin-gn; bnh: Trl—Op.	*Nit.* partly sol.	Intum.; on char. gyh. glob. containing lead.
12 C. between coch. and hyacinth-r; lemon-yw on exposure: St. brick-r: Sbtrl—op.		Fus! bn. cryst. on cooling. [slag.
13 C. hyacinth-r: St. orange-yw: Trl: Sect.	*Nit.* yw. sol, no ef.	Blackens; dec; shining
14 C. deep verdigris-, mountain-gn: St. gnh-w: Trl.		On char. met. lead.
15 C. and St. bnh-bk; ywh-bn, if weathered: Op.		2: Gently heated inflames; bk. enamel.
16 C. gn, bn: St, olive-gn—bn: Sbtrp—op.	Sol. *nit.*	Unalt; on ch. fus. with defl.; met. glob.
17 C. rdh-yw: Trp.	Insol.	1: bk. met. bead.
18 C. olive-gn: St. ywh-gn, yw: Trp—sbtrl.		1·5: *Bor.* gn glob.
19 C. honey and orange-yw: St. rdh-yw: Sbtrp.		Decomp; yw. on char.
20 C. gnh-yw, pistachio-gn: Op—sbtrl.		7: bkns, op; *bor.* clear glass.
21 C. yw or ywh-bn: St. ywh.		7: *Bor.* dark red bead.
22 C. bkh: odor argillaceous when heated.	Sol. *nit.*	
23 C. w; gyh, rdh. bnh; darkens on exposure: St. bn. Trl—sbtrp.	Ef. slowly.	7: Bkns; mag.
24 C. emerald-gn: Trp.	Sol. *mur.*	Blackens; infus.
25 C. iron-bk: St. gn.	*Mur.* sul. hyd.	4·5.
26 C. gn: St. paler: Trl—op.	Ef. *nit.*	2: Bk: *Bor.* green.
27 C. yw, bn, bk, gn, r: none bright: St. w. rh, bn. Sbtrp—op.	Sol. *mur.*	7: High heat, zinc fumes.
28 C. cochineal-, carmine-r: St. bnh-r: Sbtrp—sbtrl. Often coated with malachite.	Sol. ef. *nit*: Sol. *mur*, no ef.	2—2·5: On char. met. copper.
29 C. gn, bn; gy: St. yw: Sbtrp—sbtrl.	Sol. hot. *nit*, no ef.	1·5: Cryst. on cooling.
30 C. bright emerald-gn: St. pale apple-gn: Trp—trl.		At certain heat on ch. reduced with deflagration.
31 C. azure-b, bkh-b: St. paler: Trp—sbtrl.	Ef. *nit.*	2: Bk: *Bor.* green.
32 C. dark hair-bn; yw, gy; straw-yw: St. ywh-gy: Trp—op.		Dec; fus. glass; inod. fumes; char. ywh-bn.
33 C. dull rdh-bn: St. gyh-bn.		Fus! intum.
34 C. and St. lavender-b, leek-gn. Fibres somewhat elastic.		2: Bk. glass, shining.
35 C. dark-olive-gn: St. olive-gn: Sbtrl.		2: Bnh. glob. then rdh-[illegible] met: lastly met. cop.
36 C. and St. straw-yw: St. glimmering: Feel greasy.		[illegible] fus. dif. mag: *Bor.* [illegible] easily.

Names of Species.		Hardness.	Sp. Grav.	Structure.	Lustre.
1 *Pyrosmalite, 272.	Prim.	4.	3—3·2.	VI: Hexag; mas.	P'rly, vit.
2 Red Zinc Ore, 426.	Prim.	"	5·4—5·6.	III, fol! Mas.	Subadamant.
3 *Voltzite, 504.		4—5.	3·6—3·7.	Spher. globules.	Vit .. greasy.
4 *Flucerine, 258.		"	4·7.	VI: Mas.	Vit.
5 *Xenotime, 260.	Prim.	4·25—5.	4·5—4·6.	II, cleav.	Res.
6 *Erinite, 290.	Cop. ores.	4·5—5.	4—4·1.	Imp. cryst; concentric.	Dull, res
7 *Pseudo-Malachite, 391.	Cop. ores.	"	4·1—4·3.	VI: Col, bot, mas.	Ad .. vit.
8 *Yttro-Columbite, 405.	Prim.	4·5—5·5.	5—5·6.		Submet, res.
9 Orthite, 429.	Prim.	5.	3·2—3·3.	Long. acic. crystals.	Vit.
10 *Dioptase, 289.		"	"	VI.	Vit, .. res.
11 Pyrochlore, 434.	Prim.	"	4·2—4·3.	I. octahedrons.	Res .. vit.
12 Göthite, 450.		"	4—4·2.	III.	Subadamant.
13 *Basic Flucerine, 259.		"	4·7.	I: Mas.	Vit.
14 Triplite, 260.	Prim.	5—5·5.	3·1—3·8.	Mas, cleav.	Res .. ad.
15 Brown Iron Ore, 449.		"	3·9—4·1.	III: Bot, mas.	Ad; submet: earthy.
16 Willemite, 265.		"	4—4·1.	VI: ren, mas.	Res.
17 Monazite, 424.		"	4·8—5·1.	IV. In cryst.	Vit; res, weak.
18 *Wöhlerite, 433.	Prim.	5·5.	3·41.	Tabular; gran.	Vit .. res.
19 *Œrstedite, 432.	Prim.	"	3·6—3·7.	II.	Splend.
20 Chromic Iron, 445.	Serp.	"	4·3—4·5.	I: Mas.	Submet.
21 Pitchblende, 439.		"	6·4—6·5.	Bot, mas.	Submet.
22 Psilomelane, 441.		5—6.	4—4·4.	Mas: Bot.	Submet.
23 *Æschynite, 432.	Prim.	"	5·1—5·7.	IV: Mas.	Res.
24 Brookite, 421.		5·5—6.		III. Thin cryst.	Met-ad.
25 *Romeine, 262.	Prim	"		II. minute crystals.	
26 Warwickite, 455.	Prim.	"	3—3·3.	IV: slender cryst; mas.	Submet-p'rly.
27 *Greenovite, 423.	Prim.	5·5—7.		IV.	Vit.; splend.
28 *Sodalite, 338.	Volc., &c.	5·5—6.	2·2—2·4.	I: Mas.	Vit.
29 Yenite, 418.	Prim.	"	3·8—4·1.	III: Col; mas.	Submet.
30 *Fergusonite, 435.	Prim.	"	5·8—5·9.	II.	Fract. surf. vit, splend.
31 Chondrodite, 388.	Prim.	6—6·5.	3·1—3·3.	IV: Gran, mas.	Vit; .. res.
32 Allanite, 429.		6.	3·2—4·1.	V: Acic; mas.	Submet; res.
33 Acmite, 373.	Prim.	6—6·5.	3·2—3·3.	IV, long pointed cryst.	Vit; .. res.
34 Rutile, 420.	Prim.	"	4·2—4·3.	II; usually in cryst; [mas.	Ad—met-ad.
35 *Ostranite, 418.	Prim.	"	4·3—4·4.	III. in cryst.	Vit.
36 *Euxenite, 436.	Prim.	"	4·6.	Massive.	Met, greasy.
37 *Thorite, 430.	Prim.	"	4·6—4·7.	Massive.	Vit, res.
38 *Polymignite, 433.	Prim	6·5.	4·7—4·9.	III, usually thin and striated.	Submetallic; splendent.
39 Tin Ore, 427.	Prim.	6—7.	6·5—7·1.	II: Div, fib: mas.	Ad.
40 Gadolinite, 431.	Gran.	6·5—7.	4—4·3.	IV: Mas.	Vit; res.
41 *Titaniferous Cerite, 432.		"			Vit.

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe.*
1 C. pale liver-bn, gyh, gnh: St. paler: Trl—op.	*Nit.* sol., except silica.	2: Odorous fumes, rdh-bn: bk. slag.
2 C. r; ywh: St. orange-yw: Sbtrl—op.	*Nit.* sol. no ef.	7: *Bor.* yw. glass.
3 C. dirty rose-r, ywh.	*Mur.* fetid fumes.	
4 C. fine yw, rdh, bnh: Sbtrl—op: St. w, ywh.		7: Bkns: *Bor.* r. when hot, colorless on cool'g.
5 C. ywh-bn: St. pale-bn: Op.		7: *Bor,* milky glob. when cool.
6 C. emerald-gn, grass-gn: St. paler: Sbtrl.		
7 C. emerald-gn, bkh: St. paler: Trl—sbtrl.	Hot *nit.* sol. no ef.	Fus! vesic. submet.
8 C. bk, yw, bn: St. gy, w.		7: Dec; *soda,* froths.
9 C. bk . . ash-gy: St. bnh-gy.		Intum. ywh-bn; fus. ef. vesic. bk: *Bor.* fus.
10 C. emerald-gn, bkh: St. gn: Trp—trl.	Sol. *mur.* no ef.	7: Dec; ywh-gn flame.
11 C. rdh-bn: St. clear pale bn: Sbtrl—op.		Ywh-bn; fus. dif! *Bor.* yw glob. in ox. flame.
12 C. bn, rdh: St. bnh-yw.		Bk. mag; *Bor.* gn or yw glass.
13 C. fine yw, rdh, bnh: St. fine yw: Sbtrl—op.	*Sul.* yw: Sol. *mur.* odorous! fumes.	7: Bkns: *Bor.* like flucerine.
14 C. bkh-bn: St. ywh-gy: Sbtrp—op.	Sol. *nit;* no ef.	1·5: Bk scoria.
15 C. bn, ywh, bkh, not bright: St. ywh-bn: Sbtrp—op. Some varieties soft and earthy, or ochreous.	*Nit-mur.* sol.	Bk. mag; infus.
16 C. yw, ywh-bn, rdh-bn: St. w. or ywh. Trl—op	*Nit.* or *mur.* gel.	6: Dec, flame gn.
17 C. bn, ywh-bn, rdh-bn: St. rdh-w, bnh-w: Sbtrp—op.	*Mur.* decom. chlor.	6: *Bor.* fus. yw. op.
18 C. ywh, bnh: St. ywh-w: Trp—sbtrl.	*Mur.* sol.	Fus. ywh glass.
19 C. brown.		
20 C. iron-bk, bnh: St. bn: Infus.		7: *Bor.* fine gn. glob.
21 C. gyh-bk, iron-bk, bnh-bk: St. bk: Op.		7: *Bor.* gy. scoria.
22 C. bk, dark steel-gy: St. rdh-, bnh-bk: Op.	*Mur.* sol; odor!	7: Act. mang.
23 C. bkh: bnh-yw: St. dark-gy, nearly bk: Trl—op.		Swells; yw; *Bor.* dark yw.
24 C. hair-bn: orange-yw, rdh; St. ywh-w: Trl—op.		
25 C. hyacinth or honey-yw.		
26 C. bn, iron-bk: St. bnh or gyh.		7: *Bor.* eff. glass, gnh.
27 C. rose and flesh-r: St. rdh-w.	No action.	7: *Soda,* react. mang.
28 C. ash-gy; bn, azure-bk: St. paler: Trp—	Gel. *nit.*	2·5—3: Colorless glass.
29 C. iron-bk, dark gyh-bk: St. bk, gnh, bnh: Op.	*Mur.* sol.	2·5: On char. bk. mag. glob.
30 C. dark bnh-bk; bn. in thin scales and trl: St. pale brown: Op.		7: Gnh-yw: *Bor.* fus. dif.
31 C. yw, gnh, bn, r—light: Trp—sbtrl: Brit.		6: Loses col. op.
32 C. bnh, gnh-bk: St. gnh-gy: Op—sbtrl.		2·5: Froths; bk. scoria.
33 C. bnh-bk, ywh, gnh: St. pale gnh-gy: Sbtrl—op.		2·5—3: Bk. glob. mag.
34 C. rdh-bn, ywh: St. pale bn: Trl—op.		7: *Bor.* ywh-r. glass.
35 C. clove-bn; gyh: St. paler: Brittle.		7: *Bor.* dif.
36 C. bnh-bk: St. rdh-bn.		7: *Bor.* yw, bnh-yw.
37 C. bk; bnh: St. dark bn: frangible.		7: Pale bnh-r: *Bor.* fus. iron-colored glob.
38 C. bk; op: St. dark bn. Fract. brilliant submet.		7: *Bor.* fus! colored glob.
39 C. bn, bk: r, yw, gy, w: St. pale gyh-bn: Sbtrp—op.	Insol.	7: *Bor.* on char. tin.
40 C. gnh-bk, dark: St. gnh-gy: Sbtrl—op.	Gel. hot *nit.*	[illegible] Dec; vivid glow; on [illegible] swells, gyh-gn.
41 C. bkh-bn: Frac. conchoidal.	Acted on by acids [illegible] ells.	

ARRANGEMENT OF THE MINERAL SPECIES IN CLASS II., SECTION I., SUB-SECTION B., ACCORDING TO THEIR SPECIFIC GRAVITIES.

Green Iron Ore,	1·7—2.	Ankerite,	2·9—3·2.	Euchroite,	3·3—3·4
Chloropal,	1·7—2·1.	Cube Ore,	3.	Orpiment,	3·4—3·5
Huraulite,	2·25—2·3.	Copper Froth,	3—3·1.	Realgar,	3·4—3·7
Earthy Cobalt,	2·24.	Hisingerite,	„	Triplite,	3·4—3·8
Sulphur,	2—2·1.	Pyrosmalite,	3—3·2.	Œrstedite,	3·6—3·7
Pyrorthite,	2·1—2·3.	Siderosehisolite,	3—3·4.	Voltzite,	"
Sodalite,	2·2—2·4.	Uranite,	3·1—3·6.	Libethenite,	3·6—3·8
Iron Sinter,	2·2—2·4.	Cupreous Manga-		Allanite,	3·2—4·1
Pyrargillite,	2·5.	nese,	3·1—3·3.	Wad,	3·7
Carphosiderite,	"	Chondrodite,	"	Brochantite,	3·7—3·8
Copper Mica,	2·5—2·6.	Crocidolite,	3·2—3·3.	Blue Copper Ore,	3·7—3·82
Mysorin,	2·62.	Orthite,	"	Azurite,	3·5—3·9
Vivianite,	2·6—2·7.	Dioptase,	"	Yenite,	3·8—4·1
Cobalt Bloom,	2·9—3.	Acmite,	"	Brown Iron Ore,	3·9—4·1
Mosandrite,	"	Cronstedtite,	3·3—3·4.	Manganblende,	"
Liroconite,	2·8—3.	Cacoxene,	"	Green Malachite,	4—4·1

SECTION II. LUSTRE METALLIC.

Names of Species.	*Hardness*	*Sp. Grav.*	*Structure.*	*Streak.*
1 Native Mercury, 462.	Fluid.	13—14.	Liquid.	Met.
2 *Iodic Silver, 300.	Soft.		Fol ! mas.	Submet.
3 Wad, 444.	0·5.	3·7.	Ren ; earthy.	Earthy.
4 *Selenid of Mercury and Lead, 499.		7·3.	I : fol. grains, mas.	
5 *Flexible Silver Ore, 491.	1—1·5.		IV, fol ! ; tab. mas.	Shining.
6 Molybdenite, 500. *Prim.*	"	4·5—4·8.	VI, fol. ! fol-mas.	Lead-gy, gnh.
7 *Sternbergerite, 490. *Silver ores.*	"	4·1—4·3.	III, fol ! rose-like agg.	Black.
8 *Foliated Tellurium, 499.	"	7—7·1.	II, fol ! gran. [cryst. lam.	Bkh. lead-gy.
9 *Auro-Tellurite, 466.	"	10—11.	III : Small cryst. and	
10 Lead, 463. *Volc. & Prim.*		11—12.	I : Membranes and glob.	Shining.
11 Earthy Cobalt, 443.	Soft.	2·2—2·3.	Bot ; earthy.	Bh—bk.
12 Cupreous Manganese, 441.	1·5.	3·1—3·3.	Ren, bot.	Shining.
13 *Hisingerite, 446. *Calc spar.*	Soft.	3—3·1.	Cleav. mas ; gran.	Gnh-gy ; bnh-yw.
14 Graphite, 519.	1—2.	2—2·1.	Fol-mas : gran.	Bk, shining.
15 *Blue Copper, 486.		3·8–3·85.	Mas ; spheroid.	Lead-gy, shin.
16 *Cobaltic Galena, 497. *Gray-wacke.*	Soft.	8·4—8·5.	Mossy groups ; mas.	
17 *Graphic Tellurium, 466. *Gold.*	1·5—2.	5·7—5·8.	III : Acic ; col ; mas.	Pure steel-gy.
18 Gray Antimony, 491.	2.	4·5—4·7.	III, cleav : Div. col ; fib ; mas.	Lead- . . steel-gy.
19 Vitreous Silver, 488. *Prim.*	2—2·5.	7·1—7·4.	I : Capil ; acic ; mas.	Bkh. lead-gy.
20 Tetradymite, 501.	"	7·5—7·6.	VI, fol !	
21 *Rionite, 502.	Soft.	5·5—5·6.		Bkh.
22 *Bismuth Silver,			Acic ; mas.	
23 *Berthierite,			Columnar.	

Blende,	4—4·1.	Greenockite,	4·8—5.	*Species whose specific gravity has not been determined.*
Willemite,	"	Monazite,	4·8—5·1.	
Erinite,	"	Æschynite,	5·1—5·6.	
Göthite,	4—4·2.	Condurrite,	5·2.	Alluaudite.
Gadolinite,	4—4·3.	Miargyrite,	5·2—5·3.	Anglarite.
Psilomelane,	4—4·4.	Cupreous Anglesite,	5·3—5·5.	Arsenite of Cobalt.
Bismuth Ochre,	4·3—4·4.	Light Red Silver,	5·4—5·6.	Aurichalcite.
Aphanesite,	4·1—4·2.	Red Zinc Ore,	"	Beaumontite.
Olivenite,	4·1—4·3.	Yttro-Columbite,	5·5—6.	Black Copper.
Pseudo-Malachite,	"	Melanochroite,	5·75.	Bromic Silver.
Pyrochlore,	4·2—4·3.	Dark Red Silver,	5·7—5·9.	Brookite.
Rutile,	"	Fergusonite,	5·8—5·9.	Green Iron Ore.
Chromic Iron,	4·3—4·5.	Red Copper Ore,	5·9—6.	Melanchor.
Atacamite,	4·4—4·5.	Bismuth Blende,	5·9—6·1.	Nickel Green.
Red Antimony,	4·4—4·6.	Chromate of Lead,	6—6·1.	Nontronite.
Xenotime,	4·5—4·6.	Caledonite,	6·4.	Pinguite.
Minium,	4·6.	Pitchblende,	6·4—6·5.	Plumbic Ochre.
Thorite,	4·6—4·7.	Tin Ore,	6·5—7·1.	Titaniferous Cerite.
Flucerine,	4·7.	Vanadinite,	6·6—7·3.	Tungstic Acid.
Basic Flucerine,	"	Pyromorphite,	6·8—7·1.	Uranium Ochre.
Hausmannite,	4·7—4·8.	Wolfram,	7—7·4.	Velvet Copper Ore.
Polymignite,	4·7—4·9.	Cinnabar,	8—8·1.	Volborthite.

SECTION II. LUSTRE METALLIC.

Color, Diaphaneity, &c.	*Acids.*	*Blowpipe.*
1 C. tin white.	*Nit.* sol.	Volatilizes.
2 C. w, ywh, gn ; bk. specks of met. silver : Lam. flexible.		1 : On ch. flame violet, glob. of silver obtained.
3 C. bn, bk : Lustre dull.		Reaction of mang.
4 C. lead-gy, bh and iron-bk.		Horse-radish odor ; *soda*, mercury.
5 C. (external) nearly bk : Lam. flexible.		Yields sulph. and silver.
6 C. pure lead-gy : Sectile : Lam. flexible.	*Nit.* sol. in part.	7 : Sulph. odor.
7 C. dark pinchbeck-bn ; tarnish violet-b : Traces on paper : Lam. flexible !		On ch. b. flame : Sulph.
8 C. blackish lead-gy : Lam. flex : Sectile.	Sol ! *nit.*	1 : On ch. w. fumes, flame blue.
9 C. silver-w .. brass-yw ; rather brittle.	Sol. *nit.*	1 : Pungent odor.
10 C. lead-gy : Malleable : Soils.	Sol. hot *nit.*	1 : Volatile.
11 C. bh-bk, bnh-bk : S[illegible]e.		Odor of arsenic.
12 C. bh-bk : Lustre re[illegible]us.		7 : Bn ; *Bor.* ameth.
13 C. bk : Cross fract. earthy : Lustre sub-met.		Mag. fus. dif ; *bor*, ywh-gn.
14 C. iron-bk ; dark steel-gy : Op : Sectile.	No action.	7.
15 C. dark indigo-blue : Sectile.		Burns : b. flame.
16 C. lead-gy .. b : Soils a little : Sectile.		I : *Bor.* b.
17 C. pure steel-gy ; very sectile.	*Nit.* sol.	1 : On ch. dark gy. met. glob ; flame gnh-b.
18 C. lead-gy .. steel-gy ; tarnish : Lam, sub-flex.	*Sul.* fetid odor.	1 : On ch. odor of sulphur.
19 C. bkh-lead-gy : Malleable.	Sol. *nit.*	1·5 : Intum, glob. silver.
20 C. pale steel-gy—silver-w : Lam. elastic ; Soils paper.	*Nit.* sol.	1 : Vol ! yw. on ch.
21 C. lead-gy—cochineal-r.		Burns, violet flame and odor of horse-radish.
22 C. tin-w, [illegible] ; tarnishes : Sectile.		Ox. lead and bismuth [illegible] char.
23 C. dark steel-gy .. pinchbeck-bn.		Fumes antim.

Names of Species.	*Hardness.*	*Sp. Grav.*	*Structure.*	*Streak.*
1 *Geocronite, 493.	2—2·5.	5·85—6·4.	Mas, cleav; gran.	Light lead-gy.
2 *Feather Ore, 495.			Capillary cryst.	
3 Pyrolusite, 442.	"	4·8—5.	III: Rad; col: Mas.	Bk. [red.
4 *Miargyrite, 506.	"	5·2—5·4.	IV.	Dark cherry-
5 *Antimonial Sulphuret of Silver, 490.	"	5·5—6·2.	III, cleav: Mas.	Light steel-gy.
6 *Jamesonite, 494.	"	5·5—5·8.	III, cleav! columnar.	Steel-gy.
7 *Native Tellurium, 465.	"	5·7—6·1.	VI: Mas.	Tin-white.
8 *Acicular Bismuth, 501. *Prim.*	"	6·1—6·2.	Acic; col: mas.	Bkh-gy.
9 *Brittle Silver Ore, 489.	"	6·2—6·3	III. mas.	Iron-bk.
10 Sulphuret of Bismuth, 500.	"	6·5—6·6.	III: Acic; fol; fib; mas.	Lead-gy.
11 *Clausthalite, 497.	"	6·8—7·2.	Mas, gran; seldom fol.	Dark-gy.
12 *Selenid of Lead & Cop. 498.	"		Mas, fine gran.	gyh, gyh-bk.
13 *Cinnabar, 507.	"	8—8·1.	VI, cleav: Mas.	Red.
14 *Telluric Silver, 488.	"	8·3—8·4.	Coarse gran. masses.	Shining.
15 *Eucairite, 487.	"		Mas, thin films.	Impressed by nail, wh.
16 Bismuth, 463. *Prim.*	"	9·7—9·8.	I, cleav.	Silver-w . . r. .
17 *Plagionite, 494.	2·5.	5·4.	IV: Mas.	
18 *Selenid of Mercury, 502.	"		Mas; gran.	Shining.
19 *Boulangerite, 495.	"	5·9—6.	Plumose, mas.	
20 *Kobellite, 495.		6·25-6·35	Column., rad.	Black.
21 *Selenid of Copper, 487.			Mas.	Shining.
22 *Arsenical Antimony, 495.	2—3.	6·2.	Reniform masses, gran.	
23 *Polybasite, 489.	"	6·2—6·3.	VI: Tab; hexag: Mas.	Bk., splend.
24 *Varvacite, 444.	2·5.	4·3—4·7.	Cryst; fib, rad.	Bk.
25 *Dark Red Silver, 506.	"	5·7—5·9.	VI: Gran, mas.	Cochineal-r.
26 *Selensilver, 487.	"	8.	I: Cleav.	Iron-bk.
27 Vitreous Copper, 486.	2·5—3.	5·5—5·8.	III. Mas.	Bkh.-lead-gy.
28 *Bournonite, 484.	"	5·7—5·8.	III. Mas.	Steel-gy—bk.
29 Galena, 496.	"	7·5—7·7.	I, cleav! gran. mas.	Lead-gy.
30 Native Copper, 464.	"	8·5—8·6.	I: Fib., mas.	Copper-red.
31 Native Silver, 461.	"	10—11.	I: Capil., fib., mas.	Met.
32 Native Gold, 460.	"	12—20.	I: Cap., mas.	Met.
33 Capillary Pyrites, 471.	about 3.	5·2—5·3.	Capillary cry[illegible]	
34 Variegated Copper, 480.	3.	5—5·1.	I: Mas.	Pale gyh-bk.
35 *Antim. Copper Glance, 485.	"	5·7—5·8.	Mas. cleav.	
36 *Amalgam, 463. *Ores mer.*	2—3·5.	10·5–14.	I: Mas.	Silver-w.
37 Tellurid of Lead, 499.	3.	8·1—8·2.	Mas; cleav.	
38 *Newkirkite, 444. *Red hematite.*	3—3·5.	3·8—3·9.	In small needles.	
39 *Zinkenite, 493. *Ant. ores.*	"	5·2—5·4.	VI: Mas, fib.	St[illegible]y.
40 Native Antimony, 466.	"	6·6—6·8.	VI: Cleav: Lam. mas.	Tin-w.
41 *Native Arsenic, 467. *Prim.*	3·5.	5·6—5·8.	VI: Imit, col. mas.	Tin-w, lead-gy
42 *Antim. Copper, 487.	3—4.	4·4—5.	Prism aggreg.	Bk.
43 *Stromeyerite, 488.	"	6·2—6·3.	Massive, gran.	Shining.
44 Gray Copper, 483.	2·75—4.	4·7—5·1.	I: Tetrahed.; mas.	Bn, or like C.
45 *Manganblende, 503.	3·5—4.	3·9—4·1.	I: Cleav: Mas.	Dark-gn.
46 Blende, 503.	"	4—4·1.	I: Cleav!	Y[illegible], rdh-bn.
47 Copper Pyrites, 481.	"	4—4·2.	II: Mas.	[illegible]-bk.
48 *Tin-Pyrites, 483. *Prim.*	"	4·3—4·4.	I: Mas.	Bk.
49 Tennantite, 485.	"	4·3—4·5.	I: Mas.	Rdh-gy.
50 *Sulphuret of Iro[illegible]e-kel, 472.	"	4·60.	I: Cleav. mas.	Light bronze-bn.

Color, Diaphaneity, &c.	Acids.	Blowpipe.
1 C. light lead-gy, gyh-b.		1: Fum. antim.
2 C. dark lead-gy.		1; W. fumes antim.
3 C. iron-bk—bh. Rather sectile.	*Mur.* strong odor.	7: *Bor.* amethyst. glob.
4 C. iron-bk: Lus. met, met-ad: Op.		Fus; fum. sulph. & ant.
5 C. light steel-gy.. silver-w; also bkh-lead-gy.		1·5: W. vapors, sulph. w. met. glob.
6 C. steel-gy: Sectile.		1: W. fumes, antim.
7 C. tin-w: Rather brittle.		1: On ch. gnh. flame, vol, w. fumes.
8 C. pale bkh-lead-gy; light copper-r. tarnish.		1: B. flames, sulph.
9 C. iron-bk: Sectile.	Dilute *nit.* sol.	1: Sulph. and antim.
10 C. lead-gy: Sectile.	Hot *nit.* sol.	1: Yellow on char.
11 C. lead-gy.. bk: Rather sectile.		1: Odor horse-radish blue flame on char.
12 C. lead-gy.. violet.		
13 C. lead-gy, bnh-r, cochineal-r: Sbtrp—op.	*Nit.* sol. red fumes.	Volatile.
14 C. lead-gy.. steel-gy.		On char. fus. bk. mass.
15 C. silver-w.. lead-gy: Ductile.	Hot *nit.* sol.	Odor horse-radish; fus! on char.
16 C. silver-w, inclined to r; subject to tarnish.	Sol. *nit.*; solution white if diluted.	1: Vol., yw. on char.
17 C. bkh lead-gy: Brittle.		1: Fum. sul. and antim.
18 C. steel to bkh lead-gy.		Odor of selenium.
19 C. bluish lead-gy.		1: Fum. sul. and antim.
20 C. lead-gy—steel-gy.		1: Yw. on ch; met. glob.
21 C. silver-w.		Odor of selen.
22 C. tin-w, rdh-gy: Splendent—dull.		1: Fumes ars. and ant.
23 C. iron-bk.		
24 C. iron-bk, steel-gy: Lustre submet.		
25 C. iron-bk—lead-gy;.. coch.-red: L. met-ad.: Trl—op.		1: Dec. b. flame, sulph. and antimony fumes.
26 C. iron-bk.		Fus! *soda,* silver.
27 C. bkh- lead-gy: St. sometimes shining: Sectile.	*Nit.* sol.	2: In oxyd. flame sul.
28 C. steel-gy, bkh-lead-gy, iron-bk: Brittle.	*Nit.* sol.	Fumes arsenic or ant.
29 C. pure lead-gy: Rather sectile.		1·5: Dec. sulph. odor; on char. glob. lead.
30 C. copper-red: Ductile: Malleable.	Sol! *nit.* r. fumes.	3.
31 C. silver-w; gyh-bk. tarnish: Malleable.	Sol. *nit.*	2·5.
32 C. gold-yw; wh: Sectile; malleable.	*Nit.* not sol.	2·5.
33 C. brass-yw—bronze-yw, and steel-gy.	*Nit.* pale-gn. sol.	Fus. mag. glob. *Bor.* violet-blue.
34 C. pinchbeck-bn; copper-r—bh, tarnish: Brittle.	*Nit.* sol. except silica.	2·5: Odor garlic; w. fumes; bh. flame.
35 C. bkh-lead-gy: Brittle.		
36 C. silver-w: Brittle.	*Nit.* sol.	1: Mercury vol.
37 C. tin-white: Sectile.		1: Vol. and bead of silver; flame b.
38 C. brilliant-bk: Lustre met., splendent.		
39 C. steel-gy.		1: Vol: Wh'ns char. w. fumes.
40 C. tin-w: Rather brittle.		1: W. fumes.
41 C. tin-w, lead-gy; tarnishes to dark gray: Brittle.		1: Garlic odor, bh. flame;
42 C. lead-gy, iron-gy.		Fumes of antim.
43 C. steel-gy: Sectile.	Sol. *nit.* silvers copper plate.	1.
44 C. steel-gy.. iron-bk: Rather brittle.		1·5: Fumes arsen., ant.
45 C. iron-bk; tarnish bn: L. submet.	Pulv. *mur.* fetid.	1·5.
46 C. bn, bk; Trl—op: L. submet.	*Nit.* fetid.	7: Strong heat, w. fumes.
47 C. brass-yw; often tarnished: Brittle.	Sol. *nit.* gn.	3.
48 C. steel-gy, ywh: Brittle.		Sulph. fumes; fus. bk.
49 C. bkh-lead-gy; tarnish dark-gy.		Arsen. fumes, blue flame.
50 C. light bronze-yw: Not mag.		*Bor.* in inner flame, bk pearl.

Names of Species.	*Hardness.*	*Sp. Grav.*	*Structure.*	*Streak.*
1 *Antimonial Silver, 467.	3·5—4.	9·4—9·8.	III: Mas.	Tin-w.
2 Magnetic Pyrites, 476.	3·5—4·5.	4·5—4·7.	VI: M[illegible]	Dark gyh-bk.
3 Manganite, 441.	4—4·5.	4·3—4·4.	III: Col, mas.	Rdh-bn, bkh.
4 Platinum, 458.	"	16—19.	Irreg. masses, grains.	Steel-gray.
5 *Bismuth Nickel, 472.	4·5.	5·1—5·2.	I: Mas.	
6 Göthite, 450.	5.	4—4·2.	III.	Bnh-yw.
7 Native Iron, 457.	4—5.	7·3—7·8.	I: Mas.	Shining.
8 Brown Iron Ore, 449.	5—5·5.	3·9—4.	III: Mam, bot, mas.	Ywh-bn.
9 *Palladium, 459. *Platinum.*	"	11·8-12·5	Grains rad. structure.	Steel-gy—w.
10 Hausmannite, 440.	"	4·7—4·8.	II: Mas.	Chesnut-bn.
11 Yttro-Columbite, 435.	"	5·3—5·9.	Plates, grains on mas.	Gy.
12 *Nickel Stibine, 469.	"	6·4—6·5.	I: Mas; cleav.	
13 *White Nickel, 470.		7·1—7·2.	I: Mas.	
14 Wolfram, 439. *Prim.*	"	7·1—7·4.	III: Coarse col; lam: [mas.	Dark rdh-bn.
15 Leucopyrite, 474.	"	7·2—7·4.	III: Mas.	Gyh-bk.
16 Copper Nickel, 470.	"	7·3—7·7.	VI: Mas.	Pale bnh-bk.
17 *Irite, 456.		6·5.	In fol. grains or scales.	Met.
18 *Placodine, 471.	"	7·9—8·1.	IV: Massive.	Bk.
19 *Arsenid of Manganese, 474.	5—5·5.?	5·5—5·6.	Bot; mas; fol. or gran.	
20 Chromic Iron, 445. *Serp.*	5—5·5.	4·3—4·5.	I: Oct. cryst: Mas.	Bn.
21 Nickel Glance, 471.	"	6—6·2.	I: Lam; mas; cleav.	Gyh-bk.
22 *Uranotantalite, 438. *Prim.*	"	5·625.	Flattened grains.	Dark rdh-bn.
23 Cobaltine, 473. *Prim.*	"	6·2—6·4.	I: Mas, gran.	Gyh-bk.
24 *Cobalt Pyrites, 474. *Prim.*	"	6·3—6·4.	I: Mas.	
25 *Pitchblende, 439.	"	6·4—6·5.	Mas, bot; grains.	Bk.
26 *Antimonial Nickel, 469.	"	7·5—7·6.	Thin Hexag. plates.	Rdh-bn.
27 Psilomelane, 441.	5—6.	4—4·4.	Bot, mas.	Bnh-bk, shin.
28 Ilmenite, 454. *Prim.*	"	4·1—4·8.	VI: Mas.	Met; bk.
29 Columbite, 436. *Prim.*	"	5·9—6·1.	III: Mas.	Dark rdh-bn, [illegible]h-bk.
30 Warwickite, 455. *Prim.*	5·5—6.	3—3·3.	IV: Cleav.; mas.	Unmet.
31 *Ferrotantalite, 438. *Prim.*	5—6.	7·2—8.	III: Mas.	Rdh-bn.
32 Yenite, 448. *Prim.*	5·5—6.	3·8—4·1.	III: Col, mas.	Bk, gnh. bnh.
33 Mispickel, 475. *Prim.*	"	6—6·2.	III: Mas.	Dark gyh-bk.
34 Specular Iron, 450.	5·5—6·5.	4·5—5·3.	VI: Gran, [illegible]	Red, rdh-bn.
35 Magnetic Iron Ore, 452.	"	5—5·1.	I: Mas.	Bk.
36 Franklinite, 453. *Prim.*	"	4·8—5·1.	I: Mas.	Dark rdh-bn.
37 Smaltine, 472.	5·5.	6·4—7·2.	I: Imit; mas.	Gyh-bk.
38 *Heteroclin, 443.	6.	4·6—4·7.	IV: Mas.	Bk, bnh.
39 *Euxenite, 436. *Prim.*	6—6·5.	4·6.	Massive.	Bk-[illegible]n.
40 White Iron Pyrites, 477.	"	4·6—4·9.	III: Rad; crests; mas.	Gy[illegible]bnh-bk.
41 *Braunite, 440.	"	4·8—4·9.	II: Mas.	Bnh-bk.
42 Iron Pyrites, 478.	"	4·8—5·1.	I: Imit. mas.	Bnh-bk.
43 *Polymignite, 433. *Prim.*	6·5.	4·7—4·9.	III: Crystals long and [striated.	Dark-bn.
44 *Iridosmine, 459. *Platinum.*	6—7.	19—21.	VI: Grains.	Met.

Color, Diaphaneity, &c.	Acids.	Blowpipe.
1 C. silver-w, tin-w.		1: Fumes ant; gy. glob; finally glob. of silver.
2 C. bronze-yw . . copper-r: Brittle: Mag.	Dilute *nit.* sol.	2: Sulph. odor.
3 C. dark steel-gy . . iron-bk.		7: *Bor.* violet-b. glob.
4 C. perfect steel-gy: Ductile.	Hot *nit-mur.* sol.	7.
5 C. light steel-gy—silver-w; often tarnished yw or gy: Brittle.		Fus! mag. bead; coal ywh.
6 C. bn, rdh: Sbtrp: Lus. subadamant.		B'kns; mag; *bor*, gn or yw glass.
7 C. iron-gy: Acts on the magnet; malleable.		7: Bor. green glass.
8 C. bn, bkh-bn, ywh-bn: Sbtrp—op; not act on magnet.		7: Bk. and magnetic.
9 C. steel-gy—silver-w: Malleable.		7: With *sulphur*, fus.
10 C. bnh-bk: Lus. submet.	Hot *mur.* odor.	7: *Bor.* amethyst glob.
11 C. bk, ywh-bn: Lustre submet., res.	No action.	7: *Bor.* sol.
12 C. steel-gy . . silver-w: Brittle.		Partly vol; w. on char.
13 C. tin-w.		Arsen.: *Phos.* brit. glass.
14 C. dark-gyh—bnh-bk: Lust. submet.		2·5: Dec.; *Bor.* gn. bead.
15 C. silver-w . . steel-gy: Brittle.		2·5: No arsen. odor. *Phos.* deep-red glob.
16 C. copper-red: Brittle.	Gn. coating *nit.*	2: On char. arsen. odor.
17 C. bk.		
18 C. light bronze-yw.		
19 C. gyh-w.	*Nit-mur*, sol.	Burns b. flame; high heat ars., and charcoal w.
20 C. iron-bk . . bnh: Brittle: Often slightly mag.		7: *Bor.* fine gn; fus. dif.
21 C. silver-w, steel-gy.		2: Dec!, sul. arsen sublimes in glass tube.
22 C. velvet-bk: Lustre submet.		Burns; fus.
23 C. silver-w, rdh: Brittle.	*Nit.* eff.	On char. arsen; bk. glob. mag; *Bor.* b. glob.
24 C. pale steel-gy, rdh; tarnish copper red.	*Nit.* sol. exc't sulphur.	Dec! on ch., sul. odor; *Bor.* b. glass.
25 C. gyh, bnh, velvet-bk: Lus. submet, dull.		7: *Bor.* gray scoria.
26 C. light copper-r . . violet: Lustre splend.		Antimony sublimed.
27 C. bk, gyh—dark steel-gy: Brittle.	*Mur.* sol. odor.	7: *Bor.* violet.
28 C. dark iron-bk: Brittle; slightly mag.	Sol. strong *mur.*	7.
29 C. bnh-bk; bk: Lustre submet.		7: *Bor.* fus. dif.
30 C. bn, iron-gy: Lust. submet-pearly.		7: *Bor.* eff. gn. glass.
31 C. iron-bk: Brittle.		7.
32 C. iron-bk . . dark gy[illegible]h: Brittle; Lus. submet.	Sol. *mur.* odor.	2·5: Glob. mag. bk.
33 C. silver-w . . steel-g[illegible]ittle.	Sol. *nit.*	2·5: On ch. arsen.; mag. bead.
34 C. dark steel-gy—iro[illegible]	Hot *mur.* sol.	7: *Bor.* gn. glass.
35 C. iron-bk; attract. by mag.	Hot *mur.* sol.	7: *Bor.* ox. flame rdh gl's.
36 C. iron-bk: Acts slightly on the needle.	Hot *mur.* sol.	7: High heat, zinc fumes.
37 C. tin-w . . steel-gy.	Pulv., red fumes, *nit.*	2: Arsen. odor, gyh-bk. pearl; mag: *Bor.* b. gl's.
38 C. iron-bk . . steel-gy.		Reaction of mang.
39 C. bnh-bk: Lustre met-greasy.		7: *Bor.* yw, bnh-yw.
40 C. pale bronze-yw; gnh, gyh: Brittle.	*Nit.* sol.	2·5: Sulph. fumes.
41 C. dark bnh-bk: Lustre submet: Brittle.	Hot *mur.* odor.	7.
42 C. light bronze-yellow.	Sol. hot *nit.* except sul.	2: Odor of sulph., r.
43 C. bk: Fracture brilliant: Lustre submet, splend.		7: *Bor.* fus! col. glob.
44 C. tin-w, pale steel-gy: Brittle.		7: With *nitre*, strong odor

ARRANGEMENT OF THE SPECIES IN CLASS II, SECTION II, ACCORDING TO THEIR SPECIFIC GRAVITIES.

Graphite,	2—2·1.	Capillary Pyrites,	5·2—5·3.	Ferro-tantalite,	7·2—8.
Earthy Cobalt,	2·2—2·3.	Miargyrite,	5·2—5·4.	Columbite,	
Hisingerite,	3—3·1.	Zinkenite,	"	Selenid of Merc. and Lead,	7·3.
Warwickite,	3—3·3.	Yttro-Columbite,	5·3—5·9.	Copper Nickel,	7·3—7·7.
Cupreous Manganese,	3·1–3·3.	Plagionite,	5·4.	Native Iron,	7·3—7·8.
Wad,	3·7.	Rionite,	5·5—5·6.	Tetradymite,	7·5—7·6.
Blue Copper,	3·8—3·85.	Antimon. Sul't Silver,	"	Antimonial Nickel,	"
Newkirkite,	3·8—3·9.	Arsenid of Mang.,	"	Galena,	7·5—7·7.
Yenite,	3·8—4.	Jamesonite,	5·5—5·8.	Placodine,	7·9—8·1.
Brown Iron Ore,	3·9—4.	Vitreous Copper,	"	Selensilver,	8.
Manganblende,	3·9—4·1.	Uranotantalite,	5·6—5·7.	Cinnabar,	8—8·1.
Blende,	4—4·1.	Native Arsenic,	5·6—5·8.	Tellurid of Lead,	8·1—8·2.
Copper Pyrites,	4—4·2.	Graphic Tellurium,	5·7—5·8.	Telluric Silver,	8·3—8·4.
Göthite,	"	Bournonite,	"	Cobaltic Galena,	8·4—8·5.
Psilomelane,	4—4·4.	Dark Red Silver,	5·7—5·9.	Native Copper,	8·5—8·6.
Sternbergite,	4·1—4·3.	Native Tellurium,	5·7—6·1.	Arsenical Silver,	9·4.
Olivenite,	"	Antim. Cop'r Glance,	5·7—5·8	Native Bismuth,	9·7—9·8.
Tin Pyrites,	4·3—4·4.	Geocronite,	5·85—6·4.	Antimonial Silver,	9·4—9·8.
Manganite,	"	Boulangerite,	5·9—6.	Auro-Tellurite,	10—11.
Chromic Iron,	4·3—4·5.	Columbite,	5·9—6·1.	Native Silver,	"
Tennantite,	"	Nickel Glance,	6—6·2.	Amalgam,	10·5—14.
Varvacite,	4·3—4·7.	Mispickel,	"	Native Lead,	11—12.
Ilmenite,	4·4—4·8.	Acicular Bismuth,	6·1—6·2.	Palladium,	11·8—12·5.
Antimonial Copper,	4·1—5.	Arsenical Antimony,	6·2.	Native Mercury,	13—14.
Gray Antimony,	4·5—4·7.	Brittle Silver Ore,	6·2—6·3.	Native Gold,	12—20.
Magnetic Pyrites,	"	Polybasite,	"	Platinum,	16—19.
Molybdenite,	4·5—4·8.	Stromeyerite,	"	Iridium,	19—21.
Sulph. of iron and nickel,	4·6.	Kobellite,	6·25—6·35.		
Euxenite,	"	Cobaltine,	6·2—6·4.	*Minerals in this sub-section, whose specific gravities have not been determined.*	
Heteroclin,	4·6—4·7.	Cobalt Pyrites,	6·3—6·4.		
White Iron Pyrites,	4·6—4·9.	Nickel Stibine,	6·4—6·5.		
Hausmannite,	4·7—4·8.	Pitchblende,	"		
Polymignite,	4·7—4·9.	Smaltine,	6·4—7·2.	Iodic Silver.	
Gray Copper,	4·7—5·1.	Irite,	6·5.	Flexible Silver Ore.	
Braunite,	4·8—4·9.	Sulphuret Bismuth,	6·5—6·6.	Bismuthic Silver.	
Pyrolusite,	4·8—5.	Native Antimony,	6·6—6·8.	Feather Ore.	
Specular Iron,	4·8—5·3.	Clausthalite,	6·8—7·2.	Eucairite.	
Iron Pyrites,	4·8—5·1.	Foliated Tellurium,	7—7·1.	Capillary Pyrites.	
Franklinite,	"	White Nickel,	7·1—7·2.	[illegible]hicrite.	
Magnetic Iron,	5—5·1.	Vitreous Silver,	7·1—7·4.	Selenid of Lead and Copper.	
Variegated Pyrites,	"	Wolfram,	"	Selenid of Mercury.	
Bismuth Nickel,	5·1—5·2.	Leucopyrite,	7·2—7·4.	Selenid of Copper.	

ARRANGEMENT OF THE INSOLUBLE SPECIES HAVING AN UNMETALLIC LUSTRE AND UNCOLORED STREAK, ACCORDING TO THEIR ACTION BEFORE THE BLOWPIPE.

A. No fumes before the blowpipe.

Fusibility=1—2.
H.=1. Carb Silver.†
2. Mellite.
Cryolite.
Borate of Lime.
Hydroboracite.
Corneous Lead.
Vanadinite.
Leadhillite.
Dioxylite.
Anglesite.
3. White Lead.†
Molybdate of Lead.
Tungstate of Lead.
Pyromorphite.
4. Bismuth Blende.‡

Fusibility=2—2·5.
H.=3. Witherite.†
4. Huraulite.
Nussierite.
4·5. Apophyllite.
Triplite.
5. Triphyline.
6. Amblygonite.
Heterosite.
7. Axinite.

Fusibility=2·5—3.
H.=3·5. Heulandite.
Mesole.‡
Stilbite.
Stellite.
Laumonite.‡
4. Leucophane.
Chabazite.
Epistilbite.
Pectolite.
Thomsonite.
Natrolite.‡
Poohnalite.
Analcime.
Scolecite.‡
5. Datholite.‡
Acmite.
6. Eudialyte.‡
6·5. Idocrase.
Prehnite.
7. Boracite.
Tourmaline.

Fusibility=3—4.
H.=3. Celestine.
4. Fluor Spar.
Phillipsite.‡

H.=4. Harmotome.
Dysclasite.
Brewsterite.
5. Scapolite.
Lazulite.
Sodalite.‡
Lapis Lazuli.‡
Allanite.†
Petalite.
6. Babingtonite.
Hornblende.
Labradorite.
Hauyne.‡
Manganese Spar.
Bustamite.
Helvin.‡
6·5. Anthosiderite.
Obsidian.
Epidote.
7. Garnet.
Pyrope.

Fusibility=4—5.
H.=2. Pinite.
Lepidomelane.
Anhydrite.
3. Heavy Spar.
Haydenite.
4. Carphosiderite.
Edingtonite.
Plumbo-resinite.
Carpholite.
5. Wagnerite.
5·5. Sphene.
Hornblende.
Pyroxene.
Nepheline.‡
6. Ryacolite.
Albite.
Anorthite.
Latrobite.
Couzeranite.
6·5. Spodumene.
7. Garnet.
Pyrope.

Fusibility=5—6.
H.=2. Mica.
Chlorophyllite.
3. Fahlunite.
Gigantolite.
3·5. Spathic Iron.
Strontianite.
4. Schiller Spar.

H.=4 Dreelite.
Margarite.
Tungstate of Lime.
Tabular Spar.‡
5. Apatite.
5·5. Humboldtilite.‡
Glaucolite.
Troostite.
6. Feldspar.
Oligoclase.
Andesin.
Gehlenite.
7. Iolite.
7·5. Euclase.
8. Beryl.

Fusibility=6.
H.=1. Saponite.
Talc.
1·5. Chlorite.
Hydrous Mica.
2. Pennine.
Rosite.
3. Serpentine.
4. Pyrallolite.
Electric Calamine.‡
5. Anthophyllite.
5·5. Willemite.‡
Cummingtonite.
Hornblende.
Saussurite.
6. Chondrodite.

Infusible.
H.=1. Cimolite.
Nontronite.
Scarbroite.
Pyrophyllite.
Pissophane.
Hydro-magnesite.†
Kollyrite.
Websterite.
Halloylite.‡
Sea Foam.
Brucite.
Gypsum.
Nemalite.
Hyd. Anthophyllite.
Kerolite.
Agalmatolite.
2. Mica.
Chrysocolla.
Pyrargillite.
Picrosmine.
Bromlite.†

† Effervesces with acids. ‡ Gelatinizes either in hot or cold acids.

H.=2. Allophane.‡
3. Calc Spar.†
Gibbsite.
Villarsite.
Diallogite.†
Magnesite.†
Cacoxene.
Wavellite.
Dolomite.†
Ankerite.†
4. Arragonite.†
Barytocalcite.†
Mesitine.†
Oligon Spar.†
5. Flucerine.
Basic Flucerine.
Clintonite.

H.=5. Yttrocerite.
Alum Stone.
Calamine.†
Yttro-Columbite.
5·5. Cerite.‡
Perovskite.
Boltonite.
6. Leucite.
Periclase.
Anatase.
Turquois.
Opal.
6·5. Diaspore.
Ostranite.
Kyanite.
Bucholzite.
Tin Ore.

H.=6·5. Chrysolite.
Nephrite.
Andalusite.
7. Quartz.
Sillimanite.
Staurotide.
Zircon.
Sapphirine.
8. Topaz.
Automolite.
Dysluite.
Phenacite.
Spinel.
Chrysoberyl.
9. Sapphire.
10. Diamond.

B. Odorous or inodorous fumes on charcoal before the blowpipe.

Fusibility=1.
H.=1. Horn Silver, *od. f.*
Iodic Silver, *od. f.*
Bromic Silver, *od. f.*
Horn Quicksilver, *od. f.*
Bismuth Ochre, *w. f.*
Oxalate of Iron, *veg. f.*
2. Cotunnite, *mur. f.*
White Antim., *w. f.*

H.=3. Cerasite, *od. f.*
Mimetene, *ars. f.*
Selenate of Lead, *od.*
Bismutite, *w. f.*
4. Bismuth Blende, *w. f.*
5·5. Romeine, *w. f.*

Fusibility=2.
H.=1. Iron Sinter, *ars. f.*

H.=1. Haidingerite, *ars. f.*
Pharmacolite, *ars. f.*
2. Zinc Bloom, *w. f.*
Hopeite, *w. f.*
Chenocoprolite, *ars. f.*
Scorodite, *ars. f.*
4. Hedyphane, *ars. f.*
Pyrosmalite, *mur. f.*

EXPLANATION OF THE ABBREVIATIONS WHICH HAVE BEEN EMPLOYED, AND OF THE MANNER OF USING THE PRECEDING CLASSIFICATIONS.

The italicized words following the names of the species, point out, in general terms, the kind of strata in which the species occur, and also, in some instances, the associated minerals. We have omitted, however, any statement of the rock, when the species are found in both primary and secondary strata. The abbreviations employed are as follows :

Prim.	Primitive.	Volc.	Volcanic.	Gran.	Granite.
Amyg.	Amygdaloidal.	Serp.	Serpentine.	Limest.	Limestone.

The Roman numerals in the column of structure, indicate the crystallographic system to which the species belong, as follows :

I.	Monometric.	III.	Trimetric.	V.	Triclinate.
II.	Dimetric.	IV.	Monoclinate.	VI.	Hexagonal.

The following are explanations of the remaining abbreviations:

Lustre.

Ad.	Adamantine.
Met.	Metallic.
P'ly, P'rly.	Pearly.
Res.	Resinous.
Splend.	Splendent.
Submet.	Submetallic.
Vit.	Vitreous.

Cleavage.

Dist.	Distinct.
Ind.	Indistinct.
Perf.	Perfect.
Imp.	Imperfect.
Em.	Eminent.
Cleav.	Cleavable.

Structure.

Agg, aggreg.	Aggregated.
Bot.	Botryoidal.
Col.	Columnar.
Cryst.	Crystalline.
Del.	Deliquescent.
Div.	Divergent.
Effl.	Efflorescent.
Fib.	Fibrous.
Fol.	Foliated.
Im., Imit.	Imitative.
Mam.	Mammillary.
Mas.	*Granularly* massive and amorphous.
Pulv.	Pulverulent.
Rad.	Radiated.
Ren.	Reniform.
Stalac.	Stalactitic.
Stel.	Stellular.
Tab.	Tabular.

Color, &c.

C.	Color.
B, bh.	Blue, bluish.
Bn, bnh.	Brown, brownish.
Bk, bkh.	Black, blackish.
Gn, gnh.	Green, greenish.
Gy, gyh.	Gray, grayish.
R, rdh.	Red, reddish.
Yw, ywh.	Yellow, yellowish.
W, wh.	White, whitish.
Op.	Opaque.
Trl.	Translucent.
Sbtrl.	Subtranslucent.
Trp.	Transparent.
Trpncy.	Transparency.
Sbtrp.	Subtransparent.
St.	Streak.
T.	Taste.
Fr.	Fracture.
Sect.	Sectile.
Argil.	Argillaceous.
Lam.	Lamina.
Flex.	Flexible.

Acids.

Mur.	Muriatic acid.
Nit.	Nitric acid.
Sul.	Sulphuric acid.
Ef.	Effervescence.
Sol.	Soluble.
Insol.	Insoluble.
Gel, gelat.	Gelatinize.
Precip.	Precipitate.
Sil.	Silica.
Sul.	Sulphur.
Decomp.	Decomposed.
Exc't.	Except.
Pulv.	Pulverized.

Blowpipe.

Ch., Char.	Charcoal.
Bor. (The re-agents.)	Borax.
Soda. (The re-agents.)	Carbonate of Soda.
Phos. (The re-agents.)	Salt of Phosphorus.
Fus, infus.	Fusible, infusible.
Dif.	Difficult, difficultly.
Vol.	Volatile.
Dec.	Decrepitate.
Defl.	Deflagrates.
Det.	Detonates.
F., fum.	Fumes.
Exf.	Exfoliates.
Int., intum.	Intumesces.
Bkns.	Blackens.
Unalt.	Unaltered.
Glob.	Globular.
Vesic.	Vesicular.
Mag.	Magnetic, or capable of acting on mag. needle.
Phos.	Phosphorescent.
Sulph.	Sulphurous fumes and odor.
Ars., arsen.	Arsenical fumes and alliaceous odor.
Ant., antim.	Fumes of antimony.

The interjectional mark (!) following a word, is equivalent to the intensive adverb *very;* it is a substitute for the word *easily,* when following *fusible;* when doubled, as, (!!), the assertion is still stronger. The latter, employed as follows, *fus. diff!!,* implies that fusion takes place on the edges only.

The expression, *fol!*, designates a highly foliated structure, and very easily separable laminæ, as in *mica.*

Fol., a highly foliated structure, but laminæ less easily separable; as *anhydrite*, *native magnesia.*

Cleav!, an eminent cleavage; as in *calcareous spar*, *galena.*

Cleav., cleavage obtainable, but with less facility; as in *celestine*, *spathic iron.*

An asterisk has been affixed to the names of species not known to be American.

The colors of usual occurrence in a particular species are separated from those of occasional occurrence by a semicolon (;). Two dots, as . . , between two colors, signifies *inclining to*, as w . . r, white *inclining to* red: and when written ; . . it is to be understood as signifying, *sometimes inclining to ;* w ; . . pale r, white, *sometimes inclining to* pale red.

The figures in the blowpipe column refer to Kobell's scale of fusibility, (§ 108.)

The translations of a few examples of these abbreviated expressions will suffice to render the whole easily intelligible.

Species *Spathic Iron*, pp. 160, 161.

Hardness=3—4. Specific gravity=3·7—3·9. Crystallization rhombohedral, with a perfect cleavage; occurs also in foliated forms. Lustre vitreous or pearly.

Color yellowish-gray, ash-gray, or greenish-gray; sometimes reddish. Darkens on exposure. Subtranslucent. Pulverized it effervesces somewhat with nitric acid. Before the blowpipe it blackens, and becomes capable of influencing the magnetic needle, and fuses with some difficulty. With *borax* it forms a green globule.

Species *Axinite*, pp. 166, 167.

Color clove-brown; sometimes inclining to plum-blue and pearl-gray. Transparent—subtranslucent. Easily fusible before the blowpipe, with intumescence, to a dark green glass.

Species *Quartz*, pp. 166, 167.

Infusible alone. With *soda* it fuses easily, attended with effervescence, to a transparent glass.

Species *Topaz*, pp. 168, 169.

Infusible alone. With *borax* it slowly forms a transparent glass.

Species *Pyromorphite*, pp. 172, 173.

Color green or brown, sometimes gray. Streak yellow. Subtransparent—subtranslucent. Soluble in hot nitric acid, without effervescence. Easily fusible to a globule, which assumes a crystalline form on cooling.

The foregoing examples are probably sufficient to elucidate the abbreviated expressions.

119. The manner of using these classifications may be illustrated by an example. The obvious characters of the specimens elected for illustrating the classification, dependent on crystallography, may be supposed to be the following:

Crystalline form, according to the indications of secondary plane, a right square prism, or octahedron; cleavage distinct parallel with M, but not easily obtained. Lustre scarcely shining—vitreous inclining to pearly; hardness about 5·5; specific gravity less than 3·5. Color grayish-white. Streak grayish-white. Subtranslucent.

From the character of its crystallization and its lustre, the species belongs to the class *Dimetrica*, and section *unmetallic*. We pass on to those species whose hardness is about the same with the specimen under examination. The first we examine is *Humboldtilite*, which has a hardness represented by 5. This species, however, disagrees in color. *Hausmannite* has too high a specific gravity, and different cleavage, lustre, and color. *Scapolite* agrees in specific gravity; also in cleavage, lustre, color, and streak. Our specimen, therefore, belongs to this species. This may be rendered more certain, if there is a doubt, by examining the characters of the species that follow it, and by determining accurately its specific gravity. In general, an accurate knowledge of this last character may be dispensed with, and seldom will there be required any thing more than an approximate measurement of the inclinations of primary planes. When an uncertainty remains, after examining all the characters, the extended descriptions of those species between which the doubt lies, given in the descriptive part of this treatise, may be consulted.

The following hints will be found useful to the student who has just commenced to range the fields and hills in search of minerals.

In determining the minerals that may have been collected, the first trial should be made with a file, or the point of a knife, if a file is not at hand. If the file makes no impression, there is reason to suspect that the specimen is nothing but quartz: and if, on breaking it, no regular structure or cleavage plane is observed, but it fractures in all directions with a similar surface and a more or less vitreous lustre, the probability is very much strengthened that this conclusion is correct. In the majority of regions, quartz is the most common mineral to be met with; the stones of the soil, the pebbles of gravel beds, although so various in color, are nine tenths quartz. The specimens of this mineral are sometimes as clear and glassy as glass itself; and again they occur of every shade of tint: and often are as opaque and dull as a common brick. Some varieties break with a smooth and bright conchoidal fracture, and others with a rough granular surface, in which the grains composing the mass are seen with the naked eye. Sandstones and freestones are often wholly quartz, and the sands of the sea-shore are generally of the same material.

If the mineral is impressible with a file, and rather easily so, next try it with a little dilute muriatic acid: if an effervescence, or an escape of bubbles of air, takes place, the mineral is very probably

limestone or *calcareous spar*, which are but different names for the same chemical compound, *carbonate of lime*, the latter differing from the former only in being crystallized and somewhat purer. All the common marbles are of the same material. Limestone, like quartz, presents almost every variety of color, (though mostly of dull shades until polished,) and every degree of transparency, to the earthy opacity of common black marble.

These two minerals, although so various in their forms and appearances, may in general be thus determined with little difficulty. The blowpipe may next be used, and if no fusion is produced, the conclusion is confirmed. There would be little danger, after these trials, of confounding limestone or calc spar with any species but a few that follow it in the treatise and the specific gravity and other characters at once remove any remaining doubts.

Familiarized with these two Protean minerals, by the trials here alluded to, the student has already surmounted the principal difficulties in the way of future progress. Frequently the young beginner, who has devoted some time to collecting all the different colored stones in his neighborhood, on presenting them for names to some practised mineralogist, is a little disappointed to learn that, with two or three exceptions, his large variety includes nothing but limestone and quartz. He is, perhaps, gratified, however, at being told that he may call this specimen yellow jasper, that red jasper, another flint, and another hornstone, others chert, granular quartz, ferruginous quartz, chalcedony, prase, smoky quartz, greasy quartz, milky quartz, agate, plasma, hyaline quartz, quartz crystal, basanite, radiated quartz, tabular quartz, &c. &c.; and it is often the case, in this state of his knowledge, that he is best pleased with some old treatise on the science, in which all these various stones are treated of with as much prominence as if actually distinct species; being loth to receive the unwelcome truth, that his whole extensive cabinet contains only one mineral. But the mineralogical student has already made good progress, when this truth is freely admitted, and quartz and limestone, in all their varieties, have become familiar to him.

We conclude these remarks by repeating the observation, that trial should first be made with a file, or the point of a knife; the determination of the specific gravity should follow, if an instrument is at hand. Next, a drop of a dilute acid, or a strong acid, to ascertain whether a jelly may be formed; then the blowpipe, without, and with reagents. By these simple means, and the use of the tables given in the preceding pages, after thoroughly studying the elements of the science, there will be found little difficulty in arriving at the names of species. Crystallography affords very essential aid, and the importance of attending to its principles and working them out with models and actual crystals, cannot be too strongly urged upon the student.

PART VI.

DESCRIPTIVE MINERALOGY.

A TABULAR VIEW

NATURAL CLASSIFICATION OF MINERALS.

CLASS I.

ORDER I. RHEUTINEA.

Genus 1. Aer.

Gaseous

Sp.	1. A. terrenus,	*Carburetted Hydrogen.*
	2. A. hydrogenicus,	*Hydrogen.*
	3. A. phosphoricus,	*Phosphuretted Hydrogen.*
	4. A. fetidus,	*Sulphuretted Hydrogen.*
	5. A. azoticus,	*Nitrogen.*
	6. A. atmosphericus,	*Atmospheric Air.*
	7. A. carbonicus,	*Carbonic Acid.*
	8. A. sulphurosus,	*Sulphurous Acid.*
	9. A. muriaticus,	*Muriatic Acid.*

Genus 2. Aqua.

Liquid

Sp.	1. A. limpida,	*Water.*
	2. A. sulphurica,	*Sulphuric Acid.*

ORDER II. STERINEA.

Genus 1. ACIDUM.

H=1—2. G=1·4—3·7. *Taste weak.*

Sp. 1.	A. boracicum,	*Sassolin.*
2.	A. arsenosum,	*Arsenous Acid.*

Genus 2. BORAX.

H=2—2·5. G=1·7—1·8. *Taste sweetish alkaline.*

Sp. 1.	B. obliquus,	*Borax.*

Genus 3. ALUMEN.

H=2—3. G=1·5—1·9. *Taste styptic.*

Sp. 1.	A. plumosum,	*Feather Alum.*
2.	A. officinale,	*Alum.*
3.	A. volcanicum,	*Soda Alum.*
4.	A. magnesicum,	*Magnesia Alum.*
5.	A. ammoniacum,	*Ammonia Alum.*
6.	A. ferrosum,	*Iron Alum.*
7.	A. manganosum,	*Manganese Alum.*

Genus 4. NATRON.

H=1—3. G=1·4—2·2. *Taste alkaline.*

Sp. 1.	N. Gay-Lussianum,	*Gay-Lussite.*
2.	N. efflorescens,	*Natron.*
3.	N. permanens,	*Trona.*

Genus 5. SAL.

H=2. G=2·2—2·3. *Taste purely saline.*

Sp. 1.	S. cubicum,	*Common Salt.*

Genus 6. PICRALUM.*

H=1·5—2·5. G=1·4—2·8. *Taste saline and bitter.*

Sp. 1.	P. Glauberium,	*Glauber's Salt.*
2.	P. Thenardianum,	*Thenardite.*
3.	P. rhombicum,	*Epsom Salt.*
4.	P. vulcanicum,	*Mascagnine.*
5.	P. Vesuvianum,	*Aphthitalite.*
6.	P. octahedrum,	*Sal-Ammoniac.*
7.	P. deliquescens,	*Nitrate of Magnesia.*
8.	P. tenellum,	*Nitrate of Lime.*

* Πικρός, *bitter*, and ἅλς, *salt*. The aspirate has been dropped in the composition of this and similar words, for the sake of euphony.

Genus 7. Nitrum.

H=1·5—2. G=1·9—2·1. *Taste cooling and saline.*

Sp. 1.	N. rhombohedrum,	*Nitrate of Soda.*
2.	N. rhombicum,	*Nitrate of Potash.*

Genus 8. Vitriolum.

H=2—2·5. G=1·8—3·2. *Taste astringent and metallic; nauseous.*

Sp. 1.	V. martiale,*	*Copperas.*
2.	V. hexagonum,	*Coquimbite.*
3.	V. parasiticum,	*Yellow Copperas.*
4.	V. cyprium,	*Blue Vitriol.*
5.	V. zincicum,	*White Vitriol.*
6.	V. cobalticum,	*Cobalt Vitriol.*
7.	V. uranicum,	*Johannite.*
8.	V. bicolor,	*Botryogen.*

Genus 9. Gæalum.†

H=2·5—3·5. G=2·7—2·9. *Taste weak.*

Sp. 1.	G. obliquum,	*Glauberite.*
2.	G. columnare.	*Polyhalite.*

CLASS II.

ORDER I. HALINEA.

Genus 1. Astasialus.‡

H=1·5—2. G=1—2·5. *Decomposed in the flame of a candle.*

Sp. 1.	A. phytogeneus,§	*Oxalate of Iron.*
2.	A. obliquus,	*Oxalate of Lime.*

Genus 2. Mellis.

H=2—2·5 G=1·5—1·6. *Decomposed by boiling water.*

Sp. 1.	M. pyramidalis,	*Mellite.*

* The salts of iron were termed Martial by the alchymists, from Mars, the alchymistic name of iron.

† Γαῖα, *earth,* and ἅλς, *salt,* in allusion to the composition and slight solubility of the species.

‡ Ἄστατος, *unstable;* alludes to the facility with which the species is decomposed.

§ Φυτογενεος, *originating from plants;* the species is supposed to be of vegetable origin.

Genus 3. CRYALUS *

H=2.25—2.5 G=2.9—3 *Fusible in the flame of a candle*

Sp. 1. C. fusilis, *Cryolite.*

Genus 4. ALUMINUS.

H=1—5 G=1.7—2.8

Sp. 1. A. terrenus, *Websterite*
2 A rhombohedrus, *Alum Stone*

Genus 5 ASTRALUS

H=3.5—4 G=2.3—3.8 *Mostly stellular or divergent*

Sp. 1. A. rhombicus, *Wavellite.*
2 A. ferriferus, *Cacoxene*

Genus 6 FLUELLUS

H=4—5.5 G=2.9—3.4

Sp 1 F pyramidalis, *Fluellite*
2 F obliquus, *Wagnerite.*
3 F rhombicus, *Herderite*
4 F Childrenianus *Childrenite*
5 F octahedrus *Fluor Spar*
6 F hexagonus, *Apatite*

Genus 7 PHARMACALUS.

H=1.5—5 G=2.5—2.9 *Alliaceous fumes before the blowpipe*

Sp 1 P stellatus, *Pharmacolite*
2 P magnesiferus, *Magnesian Pharmacolite*
3 P rhombicus, *Haidingerite*

Genus 8. GYPSALUS †

H=1.5—3.5 G=2.3—3 *One or more cleavages very perfect and easily obtained Contain lime*

Sp 1 G rhomboideus, *Gypsum.*
2 G rectangulus, *Anhydrite.*

Genus 9 CALCIALUS ‡

H=2.5—4 G=2.5—3.3. *Contain lime*

Sp. 1 C rhombohedrus, *Calcareous Spar.*
2 C rhombicus, *Arragonite*
3. C Dolomii, *Dolomite.*
4. C. decolorans, *Ankerite.*

* Κρυος, ice, and ἁλς, salt, from the ready fusibility of the mineral
† Γυψος, lime, and ἁλς, salt ‡ Calx, lime

Genus 10. MAGNESIALUS.

H=1—4·5. G=2·5—3·2. *Contain magnesia.*

Sp. 1.	M. rhombohedrus,	*Rhomb Spar.*
2.	M. fibrosus,	*Magnesite.*
3.	M. pulvereus,	*Hydromagnesite.*

ORDER II. BARYTINEA.

Genus I. MARANTALUS.*

H=3—4. G=3·3—3·9. *Color darkens on exposure. Contain iron or manganese with carbonic acid.*

Sp. 1.	M. rhombohedrus,	*Spathic iron.*
2.	M. decrepitans,	*Diallogite.*

Genus 2. BARALUS.†

H=2·5—4. G=3·3—4·8. *Streak uncolored. Contain strontia or baryta.*

Sp. 1.	B. rubefaciens,‡	*Strontianite.*
2.	B. prismaticus,	*Celestine.*
3.	B. obliquus,	*Baryto-calcite.*
4.	B. Johnstonii,	*Bromlite.*
5.	B. fusilis,	*Witherite.*
6.	B. rhombohedrus,	*Dreelite.*
7.	B. ponderosus,	*Heavy spar.*

Genus 3. SPANIALUS.§

G=4—5. G=3·4—5·1.

Sp. 1.	S. hexagonus,	*Flucerine.*
2.	S. dodecahedrus,	*Basic Flucerine.*
3.	S. quadratus,	*Carbonate of Cerium.*
4.	S. rhombicus,	*Yttro-cerite.*
5.	S. peritomus,	*Xenotime.*

Genus 4. SCHEELIUS.

H=[illegible]—4·5. G=6—6·1.

Sp. 1.	S. pyramidalis,	*Tungstate of lime.*
2.	S. ochreus,	*Tungstic acid.*

---

* Μαραινω, *to fade*, alluding to the change of color consequent on exposure.
† Βάρος, *weight*, and ἅλς, *salt*.
‡ In allusion to its tinging flame red.
§ Σπάνιος, *rare*, and ἅλς; the species are salts of two rare minerals, cerium and yttrium.

Genus 5. STIMMIALUS.*

H=2·5—3. G=5·5—5·6. *Contain antimony.*

Sp. 1.	S. rhombicus,	*White antimony.*
2.	S. quadratus,	*Romeine.*

Genus 6. BISMUTALUS.

H=3—4·5. G=5·9—6·1. *Contain bismuth*

Sp. 1.	B. acicularis,	*Bismutite.*
2.	B. ochraceus,	*Bismuth Ochre.*
3.	B. dodecahedrus,	*Bismuth Blende.*

Genus 7. ZINCALUS.

H=2·5—5·5. G=4·3—4·5. *Contain zinc.*

Sp. 1.	Z. rhombohedrus,	*Calamine.*
2.	Z. peritomus,	*Electric Calamine.*
3.	Z. acrotomus,	*Willemite.*
4.	Z. diatomus,	*Hopeite.*

Genus 8. MANGANALUS.

H=3·6. G=2·25—4·0. *Contain manganese.*

Sp. 1.	M. quadratus,	*Triplite.*
2.	M. obliquus,	*Heterosite.*
3.	M. hexagonus,	*Phosphate of iron and mang.*
4.	M. fusilis,	*Huraulite.*

Genus 9. AREALUS.†

H=1·5—5. G=2·6—3·8. *Contain iron.*

Sp. 1.	A. cubicus,	*Cube Ore.*
2.	A. piceus,	*Iron Sinter.*
3.	A. trimetricus,	*Scorodite.*
4.	A. rhombicus,	*Triphyline.*
5.	A. rhomboideus,	*Vivianite.*
6.	A. divergens,	*Anglarite.*
7.	A. viridis,	*Green Iron Ore.*
8.	A. rhombohedrus,	*Pyrosmalite.*

Genus 10. COBALTALUS.

H=1·5—2. G=3. *Color some shade of red. Contain cobalt.*

Sp. 1.	C. rubellus,	*Cobalt Bloom.*

* Στίμμι, *antimony.*

† Ἄρης, *Mars*, the alchemistic name of iron, and [illegible] *salt.*

2. C. rhombicus,	*Roselite.*
3. C. ochreus,	*Arsenite of Cobalt.*

Genus 11. Cronalus.*

H=2—4·5. G=5·3—8·1. *Color white, green, blue, or red. Contain lead.*

Sp. 1. C. rhombicus,	*White Lead.*
2. C. quadratus,	*Corneous Lead.*
3. C. Vesuvianus,	*Cotunnite.*
4. C. peritomus,	*Cerasite.*
5. C. acrotomus,	*Leadhillite.*
6. C. flexilis,	*Dioxylite.*
7. C. prismaticus,	*Anglesite.*
8. C. amorphus,	*Hedyphane.*
9. C. hexagonus,	
var. 1, speciosus,	*Pyromorphite.*
var. 2, alliaceus,	*Mimetene.*
10. C. rhombohedrus,	*Nussierite.*
11. C. seleniferus,	*Selenate of Lead.*
12. C. pyramidalis,	*Molybdate of Lead.*
13. C. vanadiferus,	*Vanadinite.*
14. C. ponderosus,	*Tungstate of Lead.*
15. C. hyacinthus,	*Chromate of Lead.*
16. C. rubeus,	*Melanochroite.*
17. C. Vauquelini,	*Vauquelinite.*
18. C. diatomus,	*Caledonite.*
19. C. rhomboideus,	*Cupreous Anglesite.*
20. C. resiniformis,	*Plumbo-resinite.*
21. C. minium,	*Minium.*
22. C. ochraceus,	*Plumbic ochre.*

Genus 12. Cypralus.†

H=1—4·5. G=2·5—4·3. *Color green or blue. Contain copper.*

Sp. 1. C. cæruleus,	*Azurite.*
2. C. vulgaris,	*Green Malachite.*
3. C. zinciferus,	*Aurichalcite.*
4. C. amorphus,	*Chrysocolla.*
5. C. rhombohedrus,	*Dioptase.*
6. C. speciosus,	*Euchroite.*
7. C. acrotomus,	*Aphanesite.*
8. C. concentricus,	*Erinite.*
9. C. rectangulus,	*Liroconite.*
10. C. hemihedrus,	*Pseudo-malachite.*
11. C. dystomus,	*Libethenite.*

* Κρόνος, Saturn, the alchemistic name of lead, and ἅλς, *salt.*
† Κύπρος, copper, and ἅλς, *salt.*

12. C. acicularis, *Olivenite.*
13. C. exhalans, *Atacamite.*
14. C. foliaceus, *Copper Mica.*
15. C. decrepitans, *Copper Froth.*
16. C. Brochantianus, *Brochantite.*
17. C. vanadiferus, *Volborthite.*

Genus 13. NICCALUS.

H=2—2·5. *Contain nickel.*

Sp. 1. U. prasinus, *Nickel Green.*
2. U. Herreri, *Herrerite.*

Genus 14. URANALUS.

H=2—3. G=3·1—3·2. *Contain uranium*

Sp. 1. U. ochraceus, *Uranic ochre.*
2. U. quadratus,
var. 1, calciferus, *Uranite.*
var. 2, cupriferus, *Chalcolite.*

Genus 15. ARGENTALUS.

Sp. 1. A. cinereus, *Carbonate of Silver.*

ORDER III. CERATINEA.

Genus CERATUS.

H=1—2. G=5·5—6·5.

Sp. 1. C. cubicus, *Horn Silver.*
2. C. foliaceus, *Iodic Silver.*
3. C. viridis, *Bromic Silver.*
4. C. quadratus, *Horn Quicksilver.*

ORDER IV. OSMERINEA.

Genus 1. HYDROLUS.*

H=1—2·5. G=1·4—2·1. *Fusion difficult—infusible.*

Sp. 1. H. cerinus,† *Halloylite.*

* Ὕδωρ, *water;* refers to the large proportion of water in the species.
† *Waxy,* in allusion to its lustre.

Sp. 2	H. argilliformis,	*Kollyrite.*
3	H. adhærens,	*Scarbroite*
4.	H. pyrosmicus,*	*Pyrargillite*
5	H. roseus,	*Rosite.*
6	H. tinctus,	*Allophane.*

Genus 2. Hydrargillus.

H=2.5—3.5. G=2—2.1

Sp. 1	H. Gibbsianus,	*Gibbsite.*

Genus 3. Stylus.†

H=2—3. G=2.6—2.8. *In prisms of six or twelve sides*

Sp. 1	S. hexagonus,	*Pinite*
2	S. acrotomus,	*Fahlunite*
3	S. foliaceus	*Chlorophyllite*

Genus 4. Ophites.‡

H=2.5—4. G=2.0—2.6

Sp. 1	O. triclinatus,	*Pyrallolite*
2	O. communis,	*Serpentine*
3	O. foliaceus,	*Kerolite.*

Genus 5. Nematus.§

H=2—3. G=2.3—2.7. *Delicately columnar*

Sp. 1.	N. rectangulus,	*Picrosmine*
2	N. radiatus,	*Hydrous Anthophyllite*
3	N. gracilis,	*Nemalite*

Genus 6. Phyllinius.

H=3.5—5. G=2.5—3.2. *Foliated*

Sp. 1	P. Schilleri,	*Schiller Spar.*
2	P. Clintoni,	*Clintonite.*

Genus 7. Margaritus.

H=1.5—3. G=2—3.1 *Foliated*

Sp. 1.	M. Brucii,	*Brucite.*

* Πῦρ, *fire*, and ὀσμή, *odor*.
† Στῦλος, *a column*, in allusion to the hexagonally prismatic forms presented by the species.
‡ An old name of serpentine, derived from the Greek, ὄφις, a snake.
§ Νῆμα, *a thread*, alluding to the columnar structure of the species.
‖ Μαργαρίτης, *pearl*, alludes to the lustre.

Sp. 2. M. prismaticus, *Talc.*
3. N. olivaceus, *Chlorite.*
4. N. Sapo, *Saponite.*
5. N. rhombohedrus, *Pennine.*
6. N. exfolians, *Pyrophyllite.*

ORDER V. CHALICINEA.

Genus 1. MICA.

H=2—4·5. G=2·6—3·1. *Structure highly foliated.*

Sp. 1. M. magarina,* *Margarite.*
2. M. hexagona, *Black Mica.*
3. M. obliqua, *Common Mica.*
4. M. rhombica, *Rhombic Mica.*
5. M. rosea, *Lithia Mica.*
6. M. hydrata, *Hydrous Mica.*

Genus 2. ZEOLUS.

H=3·5—5·5. G=2—2·7. *Species volcanic or amygdaloidal, and sometimes granitic.*

Sp. 1. Z. rhomboideus, *Heulandite.*
2. Z. Brewsterianus, *Brewsterite.*
3. Z. efflorescens, *Laumonite.*
4. Z. quadratus, *Apophyllite.*
5. Z. fascicularis, *Stilbite.*
6. Z. acutus, *Epistilbite.*
7. Z. Thomsonianus, *Thomsonite.*
8. Z. hemiquadratus, *Edingtonite.*
9. Z. gemellus, *Harmotome.*
10. Z. Phillipsianus, *Phillipsite.*
11. Z. rhombicus, *Natrolite.*
12. Z. Poonahlensis, *Poonahlite.*
13. Z. flabelliformis, *Mesolite.*
14. Z. Kobellii, *Pectolite.*
15. Z. crispans, *Scolezite.*
16. Z. tenax, *Dysclasite.*

Genus 3. TESSERA.

H=5—6. G=2—3·4. *Crystallization monometric.*

Sp. 1. T. cubica, *Analcime.*
2. T. trapezohedra, *Leucite.*

---

* Alludes to the pearly lustre.

Sp. 3. T. dodecahedra, *Sodalite.*
4. T. Hauyna, *Hauyne.*
5. T. ultramarina, *Lapis-Lazuli.*

Genus 4. CHABAZIUS.

H=4—4·5. G=2—2·2. *Crystallization hexagonal.*

Sp. 1. C. rhombohedrus, *Chabazite.*

Genus 5. DATHOLUS.

H=5—5·5. G=2·9—3. *Cleavage indistinct—crystals short—never in slender prisms.*

Sp. 1. D. obliquus, *Datholite.*

Genus 6. CLASISTYLUS.*

H=6—6·5 G=2·8—3. *Color light-green; colorless. Commonly botryoidal*

Sp. 1. C. acrotomus, *Prehnite.*

Genus 7. NEPHRUS.

H=5·5—7. G=2·9—3·1. *Massive.*

Sp. 1. N. amorphus, *Nephrite.*
2. N. peritomus, *Saussurite.*

Genus 8. LAZULUS.

H=5—6. G=2·8—3·1. *Color blue or green. Cleavage indistinct.*

Sp. 1. L. amorphus, *Turquoise.*
2. L. rhombicus, *Lazulite.*

Genus 9. SPATUM.

H=4—6·5. G=2·1—2·8.

Sp. 1. S. hexagonum, *Nepheline.*
2. S. orthotomum,† *Feldspar.*
3. S. vitreum, *Ryacolite.*
4. S. triclinatum, *Albite.*
5. S. rude, *Andesin.*
6. S. Vesuvianum, *Anorthite.*
7. S. opalescens, *Labradorite.*
8. S. nitidum, *Oligoclase.*
9. S. roseum, *Latrobite.*

---

* Κλάω, *to break*, and στύλος, *a column*, in allusion to the resemblance to a broken column, often presented by the crystals of this species.

† Ὀρθός, *straight*, and τέμνω, *I cleave;* refers to the fact, that its two cleavages are at right angles with one another.

Genus 10. Scapolus.

H=5—6. G=2·9—3·3. *Crystallization dimetric.*

Sp. 1. S. pyramidalis, *Scapolite.*
2. S. Gehlenianum, *Gehlenite.*
3. S. Mellis, *Mellilite.*
4. S. eutomus, *Somervillite.*
5. S. acrotomus, *Humboldtilite.*

Genus 11. Petalus.

H—6—7. G—2·4—3·2.

Sp. 1. P. triphanus, *Spodumene.*
2. P. rhombicus, *Petalite.*

Genus 12. Grammitus.

H—4—5. G—2·5—3.

Sp. 1. G. tabularis, *Tabular spar.*

Genus 13. Spatinius.

H—5·5—6·5. G—3—3·5.

Sp. 1. S. decolorans, *Manganese spar.*
2. S. rhombohedrus, *Troostite.*
3. S. reniformis, *Bustamite.*

Genus 14. Augitus.

H—5—7. G—2·9—4.

Sp. 1. A. diatomus, *Pyroxene.*
2. A. acrotomus, *Babingtonite.*
3. A. Proteus, *Hornblende.*
4. A. phyllinus, *Anthophyllite.*
5. A. scopiformis, *Cummingtonite.*
6. A. cuspidatus, *Acmite.*
7. A. lithiferus, *Amblygonite.*

Genus 15. Epimecius.*

H—6—7. G=3·1—3·7. *Crystals usually long and slender.*

Sp. 1. E. cyaneus, *Kyanite.*
2. E. albus, *Wœrthite.*
3. E. dissiliens,† *Diaspore.*

* Ἐπιμηκης, *very long.*
† *Flying in pieces;* alludes to the action under the blowpipe.

Sp. 4. E. Bucholzianus, *Bucholzite.*
5. E. Sillimanianus, *Sillimanite.*

ORDER VI. HYALINEA.

Genus 1. CARBUNCULUS.

H=6—7·5. G=3—4·5.

Sp. 1. C. rhomboideus, *Epidote.*
2. C. dimetricus, *Idocrase.*
3. C. dodecahedrus, *Garnet.*
4. C. cubicus, *Pyrope.*
5. C. hemihedrus, *Helvine.*
6. C. decussatus,* *Staurotide.*

Genus 2. ANDALUSIUS.

H=7—7·5. G=3·1—3·2.

Sp. 1. A. prismaticus, *Andalusite.*

Genus 3. CHONDRODUS.

H=6—7·5. G=3·1—3·2.

Sp. 1. C. obliquus, *Chondrodite.*
2. C. rhombicus, *Humite.*

Genus 4. TURMALUS.

H=7—8. G=3—3·1.

Sp. 1. T. rhombohedrus, *Tourmaline.*

Genus 5. BERYLLUS.

H=7·5—8. G=2·8—3·1. *Color green—bluish—colorless.*

Sp. 1. B. hexagonus, *Beryl.*
2. B. rhomboideus, *Euclase.*
3. B. rhombohedrus, *Phenacite.*

Genus 6. SAPPHIRUS.

H=7·5—9. G=3·5—4·6.

Sp. 1. S. rectangula, *Chrysoberyl.*
2. S. octahedra, *Spinel.*

* *Crossed like the letter* X; alludes to its cruciform crystals.

Sp. 3. S. eutoma, *Automolite.*
4. S. infusilis, *Dysluite.*
5. S. rhombohedra, *Sapphire.*

Genus 7. Adamas.

H=10. G=3·1—3·6.

Sp. 1. A. octahedrus, *Diamond.*

Genus 8. Topazius.

H=8. G=3·4—3·6.

Sp. 1. T. rhombicus, *Topaz.*
2. T. Vesuvianus, *Forsterite.*

Genus 9. Chrysolus.

H=6·5—7·5. G=3·3—3·5.

Sp. 1. C. rectangulus, *Chrysolite.*
2. C. obliquus, *Ligurite.*

Genus 10. Boracius.

H=7. G=2·9—3. *Crystals monometric. Color white or gray.*

Sp. 1. B. hemihedrus, *Boracite.*
2. B. rubefaciens, *Rhodizite.*

Genus 11. Hyalus.

H=5·5—7. G=2—3·3.

Sp. 1. H. bicolor, *Iolite.*
2. H. acutus, *Axinite.*
3. H. rhombohedrus, *Quartz.*
4. H. opalinus, *Opal.*

Genus 12. Almandus.

H=6. G=2·9—3. *Fusible, and gelatinizes in acids.*

Sp. 1. A. rhombohedrus, *Eudialyte.*

Genus 13. Zircon.

H=7—8. G=4·2—4·8. *Infusible.*

Sp. 1. Z. quadratus, *Zircon.*
2. Z. rhombicus, *Ostranite.*

ORDER VII. SCAPTINEA.

Genus 1. RUTILUS.*

H=3·5—7. G=3·2—6. *Color dark-red—brownish-black. Contain Titanium.*

Sp. 1.	R. quadratus,	*Rutile.*
2.	R. obliquus,	*Sphene.*
3.	R. roseus,	*Greenovite.*
4.	R. pyramidalis,	*Anatase.*
5.	R. Brookianus,	*Brookite.*
6.	R. cubicus,	*Perowskite.*
7.	R. acrotomus,	*Monazite.*

Genus 2. CUPRIUS.

H=3·5—4. G=5·5—6. *Contain copper.*

Sp. 1.	C. octahedrus,	*Red Copper Ore.*
2.	C. ochraceus,	*Black Copper.*

Genus 3. ZINCIUS.

H=4—4·5. G=5·4—5·6. *Contain zinc.*

Sp. 1.	Z. Brucii,	*Red Zinc Ore.*

Genus 4. JOVIUS.†

H=6—7. G=6·5—7·1. *Contain tin.*

Sp. 1.	J. quadratus,	*Tin Ore.*

Genus 5. CERITUS.

H=5·5—6. G=3·1—3·2. *Contain cerium.*

Sp. 1.	C. rhombohedrus,	*Cerite.*
2.	C. Wollastonii,	*Silicate of Cerium.*

Genus 6. MELANIUS.‡

H=2·5—6·5. G=2·1—5·6. *Color brown—black.*

Sp. 1.	M. triclinatus,	*Allanite.*
2.	M. Thoriferus,	*Thorite.*
3.	M. flammans,	*Pyrorthite.*
4.	M. obliquus,	*Gadolinite.*
5.	M. Laugieri,	*Titaniferous Cerite.*

* *Red and shining.*
† From Jupiter, the alchemistic name of tin.
‡ Μέλας, *black.*

Sp. 6. M. Mengii, *Æschynite.*
7. M. quadratus, *Œrstedite.*
8. M. rectangulus, *Polymignite.*

Genus 7. Columbius.

H=5·5—6. G=5·8—8. *Contain columbium.*

Sp. 1. C. hemiquadratus, *Fergusonite.*
2. C. octahedrus, *Pyrochlore.*
3. C. Berzelii. *Yttro-Columbite.*
4. C. Keilhaui, *Eu cenite.*
5. C. rectangulus, *Columbite.*
6. C. ferrosus, *Ferro-tantalite.*
7. C. uraniferus, *Urano-tantalite.*

Genus 8. Uranius.

H=5—5·5. G=6·4—6·5. *Contain uranium.*

Sp. 1. U. amorphus, *Pitchblende.*

Genus 9. Wolframius.

H=5—5·5. G=7·1—7·4. *Contain tungsten.*

Sp. 1. W. rectangulus, *Wolfram.*

Genus 10. Manganus.

H=1—6·5. G=3·1—4·9. *Contain manganese.*

Sp. 1. M. acrotomus, *Hausmannite.*
2. M. peritomus, *Braunite.*
3. M. informis, *Psilomelane.*
4. M. cupriferus, *Cupreous Manganese*
5. M. rhombicus, *Manganite.*
6. M. prismaticus, *Pyrolusite.*
7. M. obliquus, *Heteroclin.*
8. M. cobaltiferus, *Earthy Cobalt.*
9. M. terrenus, *Wad.*

Genus 11. Siderus.*

H=1—6·5. G=5·2—5·3. *Contain iron.*

Sp. 1. S. chromiferus, *Chromic Iron.*
2. S. fibrosus, *Crocidolite.*
3. S. plumosus, *Anthosiderite.*
4. S. Hisingeri, *Hisingerite.*

* Σίδηρος, *iron.*

Sp. 5. S. foliaceus, *Cronstedtite.*
6. S. rhombicus, *Yenite.*
7. S. hæmaticus,* *Brown Iron Ore.*
8. S. rutilus, *Gothite.*
9. S. rhombohedrus, *Specular Iron.*
10. S. octahedrus, *Magnetic Iron Ore.*
11. S. zinciferus, *Franklinite.*
12. S. acrotomus, *Ilmenite.*

ORDER VIII. METALLINEA

Genus 1. FERRUM.

Sp. 1. F. octahedrum, *Iron.*

Genus 2. PLATINUM.

Sp. 1. P. cubicum, *Platinum.*

Genus 3. IRIDIUM.

Sp. 1. I. hexagonum, *Iridium.*

Genus 4. PALLADIUM

Sp. 1. P. octahedrum, *Palladium.*
2. P. rhombicum, *Selenpalladite.*

Genus 5. AURUM.

Sp. 1. A. cubicum, *Gold.*

Genus 6. ARGENTUM

Sp. 1. A. octahedrum, *Silver.*

Genus 7. HYDRARGYRUM.

Sp. 1. H. fluidum, *Mercury.*
2. H. dodecahedrum, *Amalgam.*

Genus 8. PLUMBUM.

Sp. 1. P. octahedrum, *Lead.*

Genus 9. BISMUTUM.

Sp. 1. B. octahedrum, *Bismuth.*
2. B. argentiferum, *Bismuth Silver.*

* Αἱματικός, *bloody*, in allusion to the color of the powder

Genus 10. CUPRUM.

Sp. 1. C. octahedrum, *Copper.*

Genus 11. TELLURIUM.

Sp. 1. T. hexagonum, *Tellurium.*
2. T. rhombicum, *Aurotellurite.*
3. T. graphicum, *Graphic Tellurium.*

Genus 12. STIBIUM.

Sp. 1. S. rhombohedrum, *Antimony.*
2. S. rhombicum, *Antimonial Silver.*

Genus 13. ARSENIUM.

Sp. 1. A. rhombohedrum, *Arsenic.*

ORDER IX. PYRITINEA.

Genus 1. NICCOLITES.

H=3—5.5 G=6—8.1. *Color white, or slightly reddish or yellowish. Contain Nickel.*

Sp. 1. N. eutomus, *Nickel Stibine.*
2. N. hexagonus, *Antimonial Nickel.*
3. N. cupricolor, *Copper Nickel.*
4. N. Hoffmanni, *White Nickel.*
5. N. obliquus, *Placodine.*
6. N. decrepitans, *Nickel Glance.*
7. N. capillaris, *Capillary Pyrites.*

Genus 2. COBALITES.

H=5.5—6. G=6—6.5. *Color white, grayish or reddish. Contain Cobalt.*

Sp. 1. C. octahedrus, *Smaltine.*
2. C. hemicubicus, *Cobaltine.*
3. C. cubicus, *Cobaltic Pyrites.*

Genus 3. MANGANITES.

H=5. G=5—6. *Color grayish white. Contain Manganese.*

Sp. 1. M. alliaceus, *Arsenid of Manganese.*

Genus 4. MARCASITES.

H=5—6. G=6—7·4. *Color white or grayish. Contain iron.*

Sp. 1. M. acrotomus, *Leucopyrite.*
2. M. peritomus, *Mispickel.*

Genus 5. PYRITES.

H=3—6·5. G=4·5—6·1. *Yellowish-yellow. Contain iron, or iron and copper.*

Sp. 1. P. hexagonus, *Magnetic Pyrites.*
2. P. rhombicus, *White Iron Pyrites.*
3. P. cubicus, *Iron Pyrites.*
4. P. alliaceus, *Arsenid of Copper.*
5. P. erubescens,* *Variegated Pyrites.*
6. P. pyramidalis, *Copper Pyrites.*

ORDER X. GALINEA.

Genus 1. CYPRITES.†

H=2·5—4. G=4·3—5·8. *Contain copper.*

Sp. 1. C. cubicus, *Tin Pyrites.*
2. C. tetrahedrus, *Gray Copper.*
3. C. rectangulus, *Bournonite.*
4. C. dodecahedrus, *Tennantite.*
5. C. rhombicus, *Vitreous Copper.*
6. C. lividus, *Blue Copper.*
7. C. selenicus, *Selenid of Copper.*

Genus 2. LUNITES.‡

H=1·5—1·4. G=5·5—8·5. *Contain silver.*

Sp. 1. L. selenicus, *Selensilver.*
2. L. Berzelii, *Eucairite.*
3. L. cupriferus, *Stromeyerite.*
4. L. dodecahedrus, *Vitreous Silver.*
5. L. telluriferus, *Telluric Silver.*
6. L. rhombohedrus, *Polybasite.*
7. L. rhombicus, *Brittle Silver Ore.*
8. L. peritomus, *Antim. Sulphuret of Silver.*
9. L. foliaceus, *Sternbergite.*
10. L. rhomboideus, *Flexible Silver Ore.*

---

* *Blushing;* alludes to the reddish tarnish the mineral assumes on exposure.
† *Κύπρος, copper.*
‡ From *Luna*, the alchemistic name of silver.

Genus 3 [redacted]

H—2—3·5 G—4·5—5·8 *Contain antimony.*

Sp. 1. L. diatomus, *Gray Antimony.*
2. L. Berthieri, *Berthierite.*
3. L. Svanbergii, *Geocronite.*
4. L. Zinkeni, *Zinkenite.*
5. L. acrotomus, *Jamesonite.*
6. L. capillaris, *Feather Ore.*
7. L. Boulangeri, *Boulangerite.*
8. L. alliaceus, *Arsenical Antimony.*
9. L. bismutiferus, *Kobellite.*

Genus 4. Plumbites.

H 1·5—3 G—6·8—8·5 *Contain lead.*

Sp. 1. P. cubicus, *Galena.*
2. P. cobaltiferus, *Cobaltic Galena.*
3. P. seleniferus, *Clausthalite.*
4. P. pallidus, *Selenid of Lead and Copper.*
5. P. cupro-selenicus, *Selenid of Copper and Lead.*
6. P. fusilis, *Selenid of Mercury and Lead.*
7. P. albus, *Tellurid of Lead.*
8. P. foliaceus, *Foliated Tellurium.*

Genus 5. Elasmites.†

H—1—1·5. G—4·5—4·8 *Structure foliated*

Sp 1. E. hexagonus, *Molybdenite.*

Genus 6. Bismites.‡

H 2—2·5 G 6·1—7·6 *Very fusible Contain bismuth*

Sp. 1. B. rectangulus, *Sulphuret of Bismuth.*
2. B. acicularis, *Acicular Bismuth.*
3. B. rhombohedrus, *Telluric Bismuth.*

Genus 7. Zincites.

G=5·5—5·6 *Contain zinc.*

Sp. 1. Z. flammans, *Rionite.*

---

* Λυκος, *a wolf;* gray antimony was called "lupus metallorum," *wolf of the metals,* by the alchemists

† Ἔλασμα, *a plate of metal.*

‡ Contracted from bismutites, which is derived from bismutum, the Latin of bismuth

Genus 8. ...DRARGYRITES.

H=2·5 *Contain mercury.*

Sp. 1. H. alliaceus, *Selenid of Mercury.*

ORDER XI. ADELINEA.

Genus 1. ACARPIA.*

H=3·5—4 G=3·9—4·1.

Sp. 1. A. cubica, *Manganblende*
2. A. dodecahedra, *Blende.*
3. A. rosea, *Voltzite.*
4. A. hexagona, *Greenockite.*

Genus 2. CERASIA.†

H=1—1·5 G=4·5—4·6

Sp. 1. C. rhomboidea, *Red Antimony.*

Genus 3. RUBELLA.

H=2—2·5 G=5·2—8·1

Sp. 1. R. obliqua, *Miargyrite.*
2. R. rhombohedra, *Dark-Red Silver.*
3. R. florida, *Light-Red Silver.*
4. R. pentoma, *Cinnabar.*

Genus 4. EUCHROA.‡

H=1·5—2 G=3·4—3·7

Sp. 1. E. rubella, *Realgar.*
2. E. aurea, *Orpiment.*

ORDER XII. THEIINEA.

Genus 1. SULPHUR.

Sp. 1. S. pyramidalis, *Native Sulphur.*

* Ἀκαρπος, *sterile;* alludes to the difficulty of reducing the species to the metallic state.
† Cerasus, *the cherry tree;* in allusion to the color.
‡ Εὔχροος, *finely colored.*

CLASS III.

ORDER I. PITTINEA.

Genus 1. SUCCINUM.

H=2—2·5 G=1—1·1 *Transparent—translucent Color light*

Sp. 1. S. Electrum, *Amber.*
2. S. Copallinum, *Fossil Copal.*

Genus 2. STEATUS.*

G=0·65—1·1 *Whitish Crystalline*

Sp. 1. S. acicularis, *Scheererite.*
2. S. obliquus, *Hartite.*
3. S. sebaceus, *Hatchettine*

Genus 3. BITUMEN.

H=0—2·5 G=0·8—1·2 *Amorphous Solid individuals opaque, or subtranslucent*

Sp. 1. B. flexile, *Mineral Caoutchouc.*
2. B. fragrans, *Retinite.*
3. B. amarum, *Guyaquillite.*
4. B. communis, *Bitumen.*

ORDER II. ANTHRACINEA.

Genus 1. ANTHRAX.

Lustre unmetallic

Sp. 1. A. bituminosus, *Bituminous Coal*
2. A. lapideus, *Anthracite.*

Genus 2. PLUMBAGO.

Lustre metallic

Sp. 1. P. scriptoria, *Graphite.*

* Στεαρ, *fat*

DESCRIPTION OF SPECIES.

CLASS I.

ORDER I. RHEUTINEA.

HYDROGEN. Aer hydrogenicus.

Gaseous. G.=0·0694. *Colorless.* *Inodorous* when pure. Refracting power 470.

Hydrogen is one of the elementary substances. It burns with a pale blue flame, producing but little light.

Obs. It is evolved from beds of coal and stagnant ponds.

CARBURETTED HYDROGEN. Aer fervens.

Gaseous. G.=0·5555. *Colorless.* *Odor* empyreumatic. Its power of refracting light is expressed by 1·504, that of air being 1, (Dulong.)

Composition, 75 parts of carbon, and 25 of hydrogen. Burns with a yellow flame, giving out much light.

Obs. This gas may be obtained from stagnant ponds, by stirring the muddy bottom, and is there produced by the decomposition of vegetable substances. It is most abundant in beds of coal, and often issues with much force from small cavities in the interior of coal mines, forming what is termed a *blower*. At Fredonia, Chautauque Co., New York, there is so copious a discharge of this gas through a shaft sunk into the slate rock, that it is employed for lighting the village. A gasometer of 220 cubic feet is filled in about fifteen hours. The slate contains considerable bituminous matter and some thin coaly seams. This gas is evolved at several other places in the same county, and in other parts of the State.

PHOSPHURETTED HYDROGEN. Aer phosphoricus.

Gaseous. .=1·761. *Colorless.* *Odor* alliaceous. *Taste* bitter.

Composition, according to Berzelius, Hydrogen 8·71, phosphorus 91·29. It takes fire on coming in contact with the atmosphere.

OBS. This is one of the products of vegetable decomposition, and occurs in bogs and marshy places. It is supposed to constitute the phosphoric matter called Jack o' lanterns.

SULPHURETTED HYDROGEN. AER FETIDUS.

Gaseous. G.=1·1912. *Colorless.* In *odor* and *taste* to putrescent eggs.

Composition, Sulphur 94·176, hydrogen 5·824. Burns with a pale bluish red flame.

OBS. This gas is found in all sulphurous mineral waters, and is also one of the gaseous products of volcanoes.

It occurs abundantly at the Solfatara in Italy, and with few exceptions may be perceived in every volcanic district. The various sulphur waters of the middle and western portions of our country abound with it.

NITROGEN. AER AZOTICUS.

Gaseous. G.=·9757. *Colorless. Inodorous. Tasteless.*

Nitrogen ranks among the elements.

It extinguishes a lighted candle introduced into it, and is destructive to life.

OBS. This gas is given out in great abundance over an extent of four or five acres near the town of Hoosic, N. Y., and also issues through the waters of the Lebanon Springs, which are not far distant. The Lebanon Springs are tasteless and have a temperature of 73° F., while other springs in the vicinity stand at 52°. The gas, according to Daubeny, consists of nitrogen 89·4 and oxygen 10·6, or atmospheric air 50, and pure nitrogen 50. At Canoga, Seneca Co., N. Y., there is another nitrogen spring.

There are many foreign localities. Among them may be instanced the mineral springs of Cheltenham and Harrowgate.

This gas is supposed to proceed from a decomposition of the atmosphere, and the formation of nitric acid from its oxygen and a small portion of the nitrogen.

ATMOSPHERIC AIR. AER ATMOSPHERICUS.

Gaseous. Colorless. Inodorous. Tasteless.

Composition, Nitrogen 79, oxygen 21. Supports combustion and life, and is incombustible.

CARBONIC ACID. AER CARBONICUS.

Gaseous. G.=1·5245. *Colorless.* *Taste* slightly acid. Excites a pungent sensation in the nostrils.

Composition, Carbon 27·65, oxygen 72·35. It extinguishes combustion, and destroys life.

OBS. This gas is an abundant product of volcanic countries.

The *Grotto del Cane*, near Naples, is a constant source of it. This small cave is situated near lake Albano, the supposed crater of an ancient volcano, on whose banks there now exist the natural warm baths of San Germano. The carbonic acid may possibly arise from the formation of sulphuric acid by volcanic heat, and the consequent decomposition of carbonate of lime.

Carbonic acid is evolved in large quantities from all chalybeate mineral waters. Saratoga and Ballston Springs are its most abundant sources in our own country. The mineral waters of Germany are famous as foreign localities.

SULPHUROUS ACID. AER SULPHUROSUS.

Gaseous. G.[illegible], Thenard. *Colorless.* *Taste* acid. *Odor* pungent.

Composition, according to Berzelius, Sulphur 50·144, oxygen 49·856. It dissolves readily in water, forming an acid solution, which reddens vegetable blues. It destroys life, and extinguishes combustion.

OBS. Sulphurous acid is abundantly evolved from most active volcanoes. The sulphur about volcanoes is often produced by the mixing of this gas with sulphuretted hydrogen, causing a mutual decomposition and a deposition of sulphur.

Sulphurous acid is often used for bleaching.

MURIATIC ACID. AER MURIATICUS.

Gaseous. G.=1·2847. *Colorless.* *Smell* pungent. *Taste* acid.

Composition, Hydrogen 2·74, chlorine 97·26, Berzelius.

OBS. Muriatic acid is one of the constituents of the dense smoke that issues from volcanoes when in a state of action. It is sometimes found in solution in crevices about volcanoes.

WATER. AQUA LIMPIDA.

Liquid. G.=1. *Colorless.* *Inodorous.* *Tasteless.*

Water becomes solid at 32° F., and forms ice or snow. In the solid state, it has a crystalline structure, and in the condition of snow, often presents compound crystals, having a stellated form. The angles of the right rhombic prism composing them are 120° and 60°

Composition, Oxygen 88·94, and hydrogen 11·06.

SULPHURIC ACID. AQUA SULPHURICA.

Liquid. G.=1·85. *Colorless.* *Odor* pungent. *Taste* intensely acid.

Composition of the anhydrous acid, Sulphur 40·14, oxygen 59·58.

OBS. This acid, in a diluted state, has been found in the neighborhood of several volcanoes. According to Professor Baldassari, it occurs near Sienna, in the cavities of the small volcanic mountain named Zocolino. Pictet asserts, also, that he has distilled it from a cavern near Aix, in Savoy. Thenard, however, expresses his doubts whether this acid is ever found in the free state.

ORDER II. STERIN.

SASSOLIN. Acidum Boracicum.

Boracic Acid. Sassolin, *Reuss.*

In small scales, apparently six-sided tables, and also in stalactitic forms, composed of small scales.

G.=1.48. *Lustre* pearly. *Color* white, except when tinged yellow by sulphur; sometimes gray. *Feel* smooth and unctuous. *Taste* acidulous, and slightly saline and bitter.

Composition, Boracic acid 56.38, and water 43.62. The native stalactitic salt, according to Klaproth, (Beit. iii, 97,) contains mechanically-mixed sulphate of magnesia and iron, sulphate of lime, silica, carbonate of lime, and alumina. Erdmann has stated (J. für Pr. Chem. 7, 8) that sassolin contains 3.18 per cent. by weight of ammonia, and instead of being pure boracic acid, that it is a borate of ammonia.

It fuses in a candle, and at first tinges the flame green; but this color disappears when the water of crystallization has evaporated. When cooled, the globule has a glassy appearance, and is opaque if any gypsum is present.

Obs. This species has been found most abundantly in the crater of Vulcano, one of the Lipari islands, where it forms a thin layer on the sulphur, and around the fumaroles or exits of the sulphureous exhalations. The first locality known was Sasso, a city in Sienna, Italy, from which place it derived its name Sassolin.

The hot vapors at the lagoons or boiling springs of Tuscany consist largely of boracic acid. The vapors are made to pass through water, which absorbs the boracic acid; the waters are then evaporated by means of the steam from the springs. These lagoons yield from 7 to 8 thousand pounds troy per day. The boracic acid thus obtained is in large crystalline flakes.

ARSENOUS ACID. Acidum Arsenosum.

Octahedral Arsenic Acid. Arsenous Acid. White Arsenic. Arsenikblüthe of the Germans.

Primary form, the regular octahedron, fig. 4, Pl. I. It occurs usually in minute capillary crystals, stellarly aggregated, investing other substances. Also in botryoidal and stalactitic masses.

H.=1.5. G.=3.698, Roget and Dumas. *Lustre* vitreous or silky. *Streak* white. *Color* white, occasionally with a yellowish or reddish tinge. Transparent—opaque. *Taste* astringent, sweetish.

Composition, according to Berzelius, Arsenic 75.81, oxygen 24.19.

Before the blowpipe, it is completely volatilized in white fumes. In the internal flame it blackens, and gives off an alliaceous odor.

It is soluble in hot water. Sulphuretted hydrogen causes a yellow precipitate.

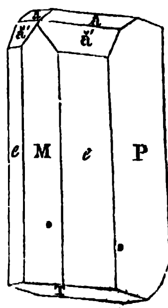
Obs. It is found accompanying ores of silver, lead, and arsenic, at Andreasberg, in the Hartz, and has probably been formed by the decomposition of some of the above

species. It occurs also at Joachimsthal in Bohemia, at Kapnik in Hungary, and in the old mines of Bieber in Hanau.

It differs from pharmacolite, which it much resembles, in its solubility. Pharmacolite is insoluble.

BORAX. Borax obliquus.

[illegible] Sweet. Tincal. Zala. Biborate of Soda.



Primary form, a right rhomboidal prism; T : T=106° 6′, M : P=90°. *Secondary form*, M : *e*=134° 5′, *e* : *e*=88° 9′., ă : ă=120° 23′. *Cleavage* parallel with M perfect; less so parallel with *e*. Compound crystals; composition parallel with M; P : P′=146° 50′.

H.=2—2·5. G.=1·716. *Lustre* vitreous—resinous; sometimes earthy. *Streak* white. *Color* white; sometimes grayish, or with a shade of blue and green. Translucent—opaque. *Fracture* conchoidal. Rather brittle. *Taste* sweetish-alkaline, feeble.

Composition, Soda 16·37, boracic acid 36·53, water 47·10.

Intumesces before the blowpipe, and afterwards fuses to a transparent globule, called the glass of borax. It is soluble in water; the solution changes vegetable blues to green.

Obs. Borax was originally obtained from a lake in Thibet, fifteen days' journey from Tisoolumbo, the capital. The water contains both borax and common salt; and being in an elevated situation, is frozen the greater part of the year. The borax is dug in considerable masses from the edges and shallow parts of the lake, and in the course of a short time, the holes thus made are again filled. This crude borax was formerly sent to Europe under the name of tincal, and there purified. It has also been found at the mines of Potosi, in Peru. It occurs also in Ceylon.

This salt is employed in several metallurgical operations as a flux, is sometimes used in the manufacture of glass and gems, and extensively in the process of soldering.

FEATHER ALUM. Alumen Plumosum.

Alunogen, *Beudant*. Neutral Sulphate of Alumina.

Usually in delicate fibrous masses or crusts; also massive.

H=2—3. *Lustre* vitreous—silky. *Color* white, or tinged with yellow or red. Subtranslucent—subtransparent. *Taste* like that of common alum.

Composition, according to Boussingault, (Ann. Ch. Ph. xxx, 109,) Hartwell, (Berz. Jahresb. x, 178,) H. Rose, (Pogg. xxvii, 317,) and Rammelsberg, (Pogg. xliii, 399,)

	Rio Saldana.	Milo.	Copiapo.	Brown Coal Friesdorf.	Alum Slate near Dresden.
Sulphuric Acid,	36·40	40·31	36.97	37·380	35·710
Alumina,	16·00	14·98	14·63	14·867	12·778
Protoxyd of Iron,	——	——	——	2·463	0·667
Protoxyd of Manganese,	——	——	——	——	1·018
Lime	——	——	——	0·149	0·640
Magnesia,	——	——	——	——	0·273
Potash,	——	soda, 1·13	——	potash, 0·215	0·324
Water,	46·60	40·94	44·64	45·164	47·022
	99·00, *B.*	97·36, *H.*	96·24, *Rose.*	100·238, *Ram.*	98·432, *Ram.*

Obs. This species appears to be the most common alum in nature.

The *alunogen* of Beudant corresponds with it in composition. It is both the result of volcanic action and of the decomposition of pyrites in coal districts and alum shales.

The Brown coal deposits of Friesdorf, near Bonn, and of Kolosoruk, near Bilin, the alum slate of Potschappel, near Dresden, and of the Cordilleras, near Saldana in Columbia, the volcano of Parto, S. A., of Milo in the Grecian Archipelago, and the province of Copiapo in Chili, are some of its foreign localities.

Feather alum occurs in efflorescences in numberless localities throughout our country; but this species has not been distinguished from the true alum. On the Catskill mountains, extending four miles north of the Clove passage, it occurs in argillaceous sandstone; also in stalactitic forms in the same mountains southwest from Cairo. Native alum occurs also at Sheffield, Mass.

POTASH ALUM. ALUMEN OFFICINALE.

Primary form, the octahedron, fig. 4, Pl. 1. *Cleavage* imperfect. Generally in fibrous masses or in efflorescences.

H.=2—2·5. G.=1·75. *Lustre* vitreous; the fibrous varieties sometimes pearly; occasionally dull. *Streak* white. *Color* white. Transparent—opaque. *Taste* sweetish-astringent, and acid. *Fracture* conchoidal.

Composition, Sulphate of alumina 21·75, sulphate of potash 11·00, and water 28·125. Melts before the blowpipe in its water of crystallization, and froths up, producing a spongiform mass of anhydrous alum. It is soluble in from 16 to 20 times its weight of cold, and in little more than its weight of boiling water.

Obs. Alum generally occurs in efflorescences on argillaceous minerals, and more particularly alum slate. Whitby, in Yorkshire, is one of its most noted localities. In the brown coal, at Tschermig, in Bohemia, it occurs in layers having a fibrous structure. It has also been obtained at the volcanoes of the Lipari isles and Sicily.

Alum is a very important material in the arts. It is used in the manufacture of leather, in dyeing, also as a preventive of putrefaction. Large artificial crystals of an octahedral form are obtained without difficulty from a saturated solution.

SODA ALUM. ALUMEN SODICUM.

Solfatarite, *Shepard*.

Occurs in fibrous crusts; fibres minute.

H.=2—3. G.=1·88. *Lustre* vitreous—pearly—silky. *Streak* white. *Color* white. Outer fibres subtranslucent or opaque; inner usually transparent. *Taste* sweetish, astringent; not differing from that of common alum.

Composition, according to Thomson, of a specimen from Mendoza,

Sulphuric acid,	37·70
Alumina,	12·00
Soda,	7·96
Water,	41·96

It is much more soluble than common alum.

Obs. It occurs at the Solfataras, in Italy, and many of the natural warm baths of that region; also in the Province of St. Juan, to the north of Mendoza, on the east side of the Andes.

MAGNESIA ALUM. ALUMEN MAGNESICUM.

Structure fibrous; also compact.

Lustre shining. *Streak* and *Color* snow-white.

Composition, according to Stromeyer, Sulphate of alumina 38·398, sulphate of magnesia 10·820, sulphate of manganese 4·597, water 45·739, chlorid of potassium 0·205=99·759.

Obs. It covers the floor of a grotto near Cape Verd, in Southern Africa, to the depth of 6 inches. The roof of the grotto is a reddish quartzose conglomerate, containing manganese and pyrites. It rests on a bed of Epsom salt, 1½ inches thick.

The *Pickeringite* of Mr. A. A. Hayes appears to be a magnesian alum. According to Mr. Hayes, it contains a considerable proportion of sulphate of magnesia and manganese, with some phosphoric acid and chlorine, which are probably accidental ingredients. The author is informed, in a communication from Mr. Hayes, that Dr. Thomson's analysis of a mineral supposed to be his Pickeringite, (Phil. Mag. xxii, 192, 1843,) must have been made on another mineral. Dr. T. found the alum he examined to consist of sulphuric acid 32·95, alumina 22·55, sulphate of soda 6·50, water 39·20=101·2.

The Pickeringite comes from near Iquique, S. A., and occurs in white columnar masses, consisting of long silky fibres.

AMMONIA ALUM. ALUMEN AMMONIACUM.

Structure fibrous; may be obtained in regular octahedrons by solution and evaporation.

H.=1—2. G.=1·56. *Lustre* resinous and shining. *Streak* and *Color* grayish-white. Transparent—translucent.

Composition, according to the analysis of Gruner, (Gilbert's Annalen, lxix, 54?)

Sulphuric acid,	33·682
Alumina,	10·750
Ammonia,	3·619
Water,	51·000=99·051.

Obs. This mineral has the general appearance of common alum, and when heated exhibits the same phenomena. It occurs at Tuckermig, in Bohemia, and was first described by Von Herder, in 1818.

IRON ALUM. ALUMEN FERROSUM.

Alumina-Sulphate of Iron.

Fibrous or feathery crystallizations. *Lustre* silky. *Color* yellowish-white. *Taste* sweetish, astringent.

Composition, according to Rammelsberg, (Pogg. xliii, 401,)

Sulphuric acid 36·025, alumina 10·914, protoxyd of iron 9·367, magnesia 0·235, potash 0·434, water and loss 43·025=100.

This corresponds with the composition of the alums. When heated it loses water and becomes red. Other compounds of sulphate of alumina and iron have been analyzed, and show very varying results. Two by Thomson gave

Sulphuric acid, 35·60 / 28·64	protoxyd of iron, 13·56 / 19·93	alumina, 7·13 / 2·85	water, 43·71 / 48·58

These and others may be mixtures of iron alum with sulphate of iron.

Obs. Resembles feather alum in appearance and taste. It occurs at Bodenmais, and at the quicksilver mine of Moersfeld. The specimens analyzed by Dr. Thomson were from the coal mines at Hurlet and Campsie, near Glasgow.

Prof. Beck considers a salt of iron found at Rossville, Richmond Co., N. Y., as an alumina-sulphate of iron. It occurs with lignite and iron pyrites.

MANGANESE ALUM. ALUMEN MANGANOSUM.

Apjohn, Pogg. xliv, 472. *Hausmann* and *Stromeyer*, Berz. Jahresb. 1835, p. 198.

Fibrous crystallizations like amianthus, with a silken lustre. Taste and solubility like common alum; but system of crystallization probably different.

Composition, according to Apjohn,

Sulphuric acid 32·79, alumina 10·65, protoxyd of manganese 7·33, sulphate of magnesia 1·08, water 47·60=99·45.

GAY-LUSSITE. NATRON GAY-LUSSIANUM.

Boussingault, Ann. de Ch. et de Ph. xxxi, 270. Hemi-prismatic Kuphone-Haloid, *M.*

Primary form, an oblique rhombic prism; M : M=68° 50′, P : M=83° 30′. *Cleavage* parallel with M perfect; parallel with P less so. Usually the crystals have the edge *ē* truncated.

H.=2—3. G.=1·92—1·99. *Lustre* (obtained by fracture) vitreous. *Streak* grayish. *Color* yellowish-white. Translucent. Exhibits *double refraction*. *Fracture* conchoidal. Extremely *brittle*. Not phosphorescent by friction or heat.

Composition, as determined by J. B. Boussingault, (Ann. de Ch. vii, 2d ser. 488, 1843,) is as follows:

Carbonate of soda,	34·5
Carbonate of lime,	33·6
Water,	30·4
Clay,	1·8=100

Heated in a matrass, the crystals decrepitate and become opaque. If then submitted to the action of the blowpipe, it fuses rapidly into an opaque globule, which is nearly infusible, and has an alkaline taste. In nitric acid, dissolves with a brisk effervescence, and by spontaneous evaporation yields crystals of nitrate of soda, floating in a solution of nitrate of lime. It is partially soluble in water, and reddens turmeric.'

OBS. This mineral occurs in abundance at Lagunilla, near Merida, in Maracaibo. Its crystals are disseminated at the bottom of a small lake, in a bed of clay, covering trona. In allusion to its crystalline form, the natives call it *clavos* or *nails*, and distinguish the trona by the name *urao*. It was named by Boussingault, in honor of the celebrated French chemist, Gay-Lussac.

NATRON. NATRON EFFLORESCENS.

Hemi-prismatic Natron-Salt, *M.* Carbonate of Soda.

Primary form, an oblique rhombic prism; P : M=71° 17′, M : M=76° 28′. Generally occurs in efflorescent crusts.

H.=1—1·5. G.=1·423. *Lustre* vitreous—earthy. *Streak* white. *Color* white; sometimes gray or yellow, owing to the presence of foreign ingredients. *Taste* alkaline.

Composition, according to Beudant,

	From Debrezin.	From Egypt.
Carbonate of soda,	73·6	74·7
Water,	13·8	13·5
Sulphate of soda,	10·4	7·5
Chlorid of sodium,	2·2	3·1
Earthy matter,	—	1·4

Effervesces strongly with nitric acid. Effloresces when exposed to the air, giving out its water of crystallization.

OBS. It occurs at Debreczin, in Hungary, according to Klaproth, (Beitrage, iii, 83,) and also at Montenovo, near Naples. It is obtained in larger quantities at the soda lakes of Egypt. Other localities exist in Asia and South America.

TRONA. NATRON PERMANENS.

Prismatoidal Trona Salt, *M.* Sesquicarbonate of Soda. Prismatic Natron, *J.* Urao.

Primary form, a right rhomboidal prism; M : T=103° 15′. Often occurs in fibrous masses consisting of a congeries of minute crystals.

H.=2.5—3. G.=2·11. *Lustre* vitreous, glistening. *Color* gray, or yellowish-white. Translucent. *Taste* alkaline. Not altered by exposure to a dry atmosphere.

Composition, according to Klaproth (Beit. iii, 83.) Carbonic acid 38, soda 37, water 22.5, sulphate of soda 2.5=100.

Obs. To this species belongs the urao found at the bottom of a lake in Maracaibo, a day's journey from Merida in South America. The specimen analyzed by Klaproth came from the province of Suckenna, two days' journey from Fezzan, Africa. It is found at the foot of a mountain, and forms a crust, varying from the thickness of an inch to that of the back of a knife.

COMMON SALT. SAL CUBICUM.

Hexahedral Rock Salt, *M.* and *J.* Rock Salt. Muriate of Soda, *P.* Chlorid of Sodium. Naturlich Kochsalz, *W.* Steinsalz, *L.* Soude Muriatée, *H.* Sal cubicum, *Hert.* Sal gemmae.

Primary form, the cube. *Secondaries*, figs. 2, 3, 4, 5, 7, 10, Pl. I. *Cleavage* parallel with the primary faces. *Imperfect crystallizations*, massive. *Structure* columnar or granular.

H.=2. G.=2·257. *Lustre* vitreous. *Streak* white. *Color* white, also sometimes yellowish, and reddish or bluish; often colorless. Transparent—translucent. *Fracture* conchoidal. Rather brittle. *Taste* purely saline.

It consists essentially of chlorid of sodium (chlorine 59.5, and sodium 40.5,) but is commonly mixed with small portions of sulphate of lime, chlorid of calcium, and chlorid of magnesium.

It dissolves readily in three times its weight of water. It attracts moisture, but is unchanged in a dry atmosphere. When heated it usually decrepitates with violence, owing to the water between the laminæ. The native rock salt containing no water, fuses at a red heat without decrepitation.

Obs. Common salt usually occurs in extensive but irregular beds in rocks of various ages, associated with gypsum, polyhalite, clay, sandstone, and calcareous spar; also dissolved, and forming salt springs.

In Europe it usually occurs in the new red sandstone, or associated with red marl; but it is not confined to these rocks. At Durham, Northumberland, and Leicestershire, England, salt springs arise from the carboniferous series; in the Alps, some salt works are supplied from oolitic rocks; the famous mines of Cardona and Wielezka are referred, the former to the green sand formation, and the latter to tertiary rocks. Salt springs also occur in volcanic regions. In the United States the salt brines mostly come from the sandstones below the coal. It also occurs as efflorescences over the dry prairies of the Rocky mountains, and California, and in most desert or semi-desert regions there are frequent salt lakes.

The principal mines of Europe are at Wielezka in Poland; those of the Salzkammergut, in Upper Austria; Ischl, Hallein in Salzburg; Hall, in the Tyrol; Bex, in Switzerland; and Northwich, in Cheshire. At the latter place it occurs in a basin-shaped deposit, and is arranged in spheroidal masses, from 5 to 8 feet in diameter, which are composed of concentric coats, and present polygonal figures. It is but little contaminated with impurities, and is prepared for use by merely crushing it between iron rollers. At the Austrian mines, where it contains much clay, the salt is dissolved in large chambers, and

the clay thus precipitated. After ten days or a fortnight, the water, fully saturated with the salt, is conveyed by aqueducts to evaporating houses, and the chambers, after being cleared out, are again filled.

It also occurs in the sandy regions of Africa and Persia, where it has resulted from the evaporation of salt water. A beautiful pure white variety now fills Lake Mareotis, near Alexandria, Egypt; at a distance it resembles a bank of snow.

In the United States it has been found forming large beds with gypsum, in Virginia, Washington Co., 18 miles from Abingdon, and in the Salmon River mts. of Oregon. Brine springs are very numerous in the Middle and Western States. The most famous of these springs are at Salina, in N. Y., and in the Kenawha and Muskingum Valleys, Ohio, and in Kentucky. The salt water is obtained by boring, and raised by means of machinery, and thence conveyed by troughs to the boilers, where it is evaporated usually by the direct application of artificial heat; sometimes by the heat of steam, and occasionally by exposure to the heat of the sun.

The following table by Prof. Beck (*Mineralogy of New York*, p. 112) gives the amount of brine required for a bushel of salt at the principal salt springs in our country:

	Galls.		Galls
Boon's Lick, Missouri,	450	Kenawha, Virg.	75
Conemaugh, Penn.	300	Grand River, Ark.	80
Shawneetown, Ill.	280	Illinois River, Ark.	80
Jackson, Ohio,	213	Montezuma, N. Y.	70
Lockhart's, Miss.	180	Grand Rapids, Mich.	50–60
St. Catherines, Upper Canada,	120	Muskingum, Ohio,	50
Zanesville, Ohio,	95	Onondaga—old wells,	40–45
		New wells,	30–35

Sea water at Nantucket gives a bushel of salt for every 350 gallons.

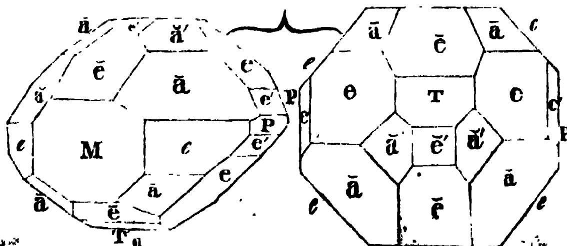
Composition of New York brines, according to Beck,

	Syracuse.	Salina, old well.	Liverpool.
Carbonic acid,	0·007	0·009	0·007
Oxyd of iron, silica, and trace of carb. lime,	0·002	0·001	0·003
Sulphate of lime,	0·569	0·472	0·404
Carbonate of lime,	0·011	0·017	0·013
Chlorid of magnesium;	0·046	0·051	0·077
Chlorid of calcium,	0·083	0·104	0·172
Chlorid of sodium, (pure salt,)	13·239	14·002	14·285
Water, with a trace of organic matter, etc.	86·040	85·341	85·039

GLAUBER'S SALT. Picralum Glauberianum.

Prismatic Glauber Salt, *M.* Sulphate of Soda. Exanthalose, *Beudant.*

Primary form, an oblique rhombic prism. *Secondary form*, M : e=133° 15½′ e : e=86° 31′, M : ĕ=104° 41′, M : ē=132° 4′, ā : ā =93° 12′, M : T=72° 15′.



[illegible] in efflorescent crusts.

H.=[illegible]—2. G.=1·481. *Lustre* vitreous. *Color* white. Transparent—opaque. *Taste* cool, then feebly saline and

Composition, according to the analysis of Reuss, (Chem. Med. Besch. des Kaiser Franzens Bades, Dresden, 1794,) is, Sulphate of soda 67·024, carbonate of soda 16·333, chlorid of sodium 11·000, chlorid of calcium 5·643=100·000. The artificial salt contains 10 parts of water, and the native salt but 2 parts, as in Beudant's *Exanthalose*, which consists of sulphuric acid 44·8, soda 35·0, water 20·2, (Vesuvius.).

Obs. It occurs at Ischel and Halstadt, in Austria, also in Hungary, Switzerland, Italy, Spain, &c. At Kailua, on Hawaii, Sandwich Islands, it occurs abundantly in a cavern, and is constantly forming from the action of volcanic heat and gases on salt water. It forms efflorescences with other salts on the limestone below the Genessee Falls, Rochester, N. Y.

The artificial salt was first discovered by a German chemist by the name of Glauber, and hence its name.

THENARDITE. Picralum Thenardianum.

J. L. Casasera, Am. de Ch. et de Ph. xxxii, 311.

Primary form, a right rhombic prism, fig. 72, Pl. II, M : M=125°. *Secondary forms*, figs. 75, 76, Pl. II. *Cleavage* perfect parallel with the primary faces, most so parallel with P.

H.=2—2·5. G.=2·73. *Lustre* vitreous. *Color* white. Translucent. Becomes covered with a white powder on exposure to the light.

Composition, according to Casaseca, Anhydrous sulphate of soda 99·78, carbonate of soda 0·22. It is wholly soluble in water. Colors the blowpipe flame deep yellow.

Obs. The only known localities of this mineral is Espartine, in Spain, a place 5 leagues from Madrid, and 2½ from Aranjuez. The water exudes from the bottom of a basin during winter, and becoming concentrated in the summer season, deposits crystals of Thenardite. This species was named in honor of the celebrated French chemist, Thenard.

EPSOM SALT. Picralum rhombicum.

Prismatic Bitter Salt, *M.* Sulphate of Magnesia.

Primary form, a right rhombic prism; M : M=90° 38′, fig. 72, Pl. II. *Secondary forms*, fig. 75, Pl. II, the planes e being enlarged, and the acute lateral edges also replaced. Other crystals have, in addition, the obtuse lateral edges truncated. *Cleavage* perfect parallel with ĕ. *Imperfect crystallizations*, botryoidal masses and delicately fibrous crusts.

H.=2·25. G.=1·751. *Lustre* vitreous—earthy. *Streak* and *color* white. Transparent—translucent. *Taste* bitter and saline.

Composition, when pure, Magnesia 16·70, sulphuric acid 32·40, water 50·90.

It deliquesces before the blowpipe, but is difficultly fusible before the water of crystallization is driven off. It is very soluble in water. It does not effervesce with the acids.

Obs. This salt is a frequent ingredient in mineral waters, and also occurs often as efflorescences on rocks. In the former state it exists at Epsom, whose springs have long been famous. This place, originally named Ebshamus, gave the name to this salt. At Idria, in Carniola, it occurs in silky fibres, and is hence called *hairsalt* by the workmen. It is also obtained at the gypsum quarries of Montmartre, near Paris, at Arragon in Spain, in the Cordillera of St. Juan in Chili, and in a grotto in Southern Africa, where it forms a layer 1½ inches thick. The salt from this last locality was analyzed by Stromeyer, and found to contain sulphate of magnesia 42·654, sulphate of manganese 07·667, water 49·243 =99·564. The roof of the grotto is a quartzose conglomerate, containing manganese and pyrites.

The floors of the limestone caves of Kentucky, Tennessee, and Indiana are, in many instances, covered with Epsom salt, in minute crystals, mingled with the earth. In the Mammoth Cave, Kentucky, it adheres to the roof in loose masses like snow balls. It efflo-

resces from the calcareous sandstone, ten miles from Cocymans, on the east face of the Heidelberg, N. Y.

MASCAGNINE. Picralum vulcanicum.

Mascagnin, *Karsten.*

Primary form, a rhombic prism. *Cleavage* parallel with the longer diagonal. Usually in mealy crusts and stalactitic forms.

Lustre of crystallized mascagnine, vitreous. *Color* yellowish-gray, lemon-yellow. Translucent. *Taste* pungent and bitter.

Composition, Sulphuric acid 53·28, ammonia 22·81, water 23·91. It dissolves readily in water.

It occurs about volcanoes, in the fissures of the lava; more particularly at Etna, Vesuvius, and the Lipari Isles. It was named in honor of Prof. Mascagni, its discoverer.

APHTHITALITE. Picralum Vesuvianum.

Vesuvian Salt, Lond. Phil. Trans. 1813.

Primary form of artificial crystals, right rhombic prisms; M : M=112° 8′, *a* : *a*=106° 46′. It has been observed in nature only in a massive state, presenting imperfectly mammillary forms, which are sometimes composed of concentric coats.

H.=2—3. G.=1·731. *Lustre* vitreous. *Color* white, sometimes tinged with blue or green. Translucent. *Taste* saline and bitter, disagreeable.

Composition, according to an analysis in the Philosophical Transactions, 1813, Sulphate of potash 71·4, sulphate of soda 18·6, muriate of soda 1·6, muriate of ammonia, copper, and iron 5·4=100.

It fuses readily before the blowpipe, without intumescence, and effervesces strongly with sulphuric acid.

Obs. Its only known locality is Vesuvius, where it occurs upon the lava in masses, often an inch or more in thickness.

Aphthitalite was so named from ἄφθιτος, *indestructible*.

SAL-AMMONIAC. Picralum octahedrum.

Octahedral Ammoniac Salt, *M.* Muriate of Ammonia, *P.* Naturlicher Salmiak, *W.* Salmiak, *L.* Ammoniaque Muriatée, *H.*

Primary form, the regular octahedron. *Secondaries*, figs. 1 and 16, Pl. I. *Cleavage* parallel with the faces of the octahedron. *Imperfect crystallizations*, stalactitic and globular masses; in crusts, or as an efflorescence.

H.=1·5—2. G.=1·528. *Lustre* vitreous. *Streak* white. *Color* white; often yellowish or grayish. Translucent—opaque. *Fracture* conchoidal. *Taste* saline and pungent.

Composition, according to Klaproth, (Beit. iii, 39 and 92,)

	Vesuvius.	Bucharia.
Muriate of ammonia,	99·5	97·50
Sulphate of ammonia,	0·5	2·50

It dissolves readily in about three times its weight of water; but does not deliquesce. It is completely volatile before the blowpipe, rising in white fumes. Mingled in the pulverized state with quicklime, it gives out the pungent odor of ammonia.

Obs. It occurs in the cracks and fissures of volcanoes, as at Etna, the island of Vulcano, Vesuvius, and the Sandwich Islands; and in large masses 4 to 6 inches thick at Deception Island, one of the South Shetlands. It has been observed in small quantities in the vicinity of ignited coal seams, as at St. Etienne, in France, and also at Newcastle, and in Scotland. It occurs also in Bucharia.

Sal ammoniac has not been found in nature in sufficient quantities for commerce. It is a valuable article in medicine, and is employed by tinmen to prevent the oxydation of metallic surfaces that are to be tinned or soldered.

The ἅλς ἀμμωνιακός, sal-ammoniac of Dioscorides, Celsus, and Pliny, is fully proved by Beckmann, (Hist. of Inventions, IV, 360,) to be common rock salt. It is described by Pliny as a native salt, dug in Egypt, near the oracle of Ammon, whence its name; this name was afterwards transferred to the muriate of ammonia, when, subsequently, it was manufactured in Egypt. Sal-ammoniac is not supposed to have been entirely unknown to the ancients, but to be described, in connection with one or two other species, under the name of *nitrum*, which, according to Pliny, gave the test of ammonia when mingled with quicklime. (Moore's Ancient Mineralogy, p. 96.)

NITRATE OF MAGNESIA. Picralum deliquescens.

In deliquescent efflorescences. *Color* white.

Composition, Nitric acid 72, and magnesia 28. Very deliquescent.

Obs. Occurs in limestone caverns with nitrate of lime.

NITRATE OF LIME. Picralum tenellum.

In efflorescent silken tufts and masses. *Color* white or gray.

Composition, Lime 32, nitric acid 57·44, and water 10·56. On burning coals it slowly fuses with a slight detonation, and dries. Very deliquescent before, but not after being desiccated by heat.

Obs. It occurs in silky efflorescences, in the limestone caverns of Kentucky. It is employed in the manufacture of saltpetre.

NITRATE OF SODA. Nitrum rhombohedrum.

Rhombohedral Nitre-Salt, *M.* Natron-Saltpetre, *Leonh.*

Primary form, a rhombohedron; R : R=106° 33′. *Cleavage* perfect parallel to R. In efflorescences; also massive, granular. H.=1·5—2. G.=2·0964; 2·290, (Tarapaca,) Hayes. *Lustre* vitreous. *Color* white; also, reddish-brown, gray, and lemon-yellow. Transparent. Rather sectile. *Fracture* indistinctly conchoidal. *Taste* cooling.

Composition, Nitric acid 54·97, and soda 45·03.

It deflagrates on charcoal with less violence than nitre, causing a yellow light. It dissolves in three parts of water at 60° F. Negative electricity is excited by friction.

Obs. There is a large deposit of this salt in the district of Tarapaca, near the northern frontier of Chili, constituting beds several feet in thickness, occurring over an extent of forty leagues in length. The country is a dry elevated pampa in the form of a basin, the surface of which consists of sand, clay, and saline matters. Recent shells are scattered over it, indicating that the whole region has been under the sea at no very remote period. The saline matters are mostly common salt, nitrate of soda, gypsum, and sulphate of soda. A. A. Hayes obtained for the purer masses of nitrate of soda, (Sill. Jour. xxxix, 375.) nitrate of soda 64·98, sulphate of soda 3·00, common salt 28·69, iodic salts 0·63, shells and marl 2·60=99·90. See a farther notice by A. A. Hayes, from the journal of Mr. J. H. Blake, in Silliman's Journal, xxxix, 375.

Large quantities have been transported to Europe, and in Great Britain it is used in some manufactures as a substitute for nitre. On account of deliquescing, it is unfit for the manufacture of gunpowder.

NITRE. NITRUM RHOMBICUM.

Prismatic Nitre-Salt, *M.* Nitrate of Potash.

Primary form, a right rhombic prism; M : M about 120°. The artificial crystals usually have the acute lateral edges truncated, and the acute solid angles deeply replaced. Occurs generally in thin crusts, and delicate acicular crystallizations.

H.=1. G.=1·937, Hassenfratz. *Lustre* vitreous. *Streak* and *Color* white. Subtransparent. Brittle. *Taste* saline and cooling.

Composition, according to Klaproth's analysis of an African specimen, (Beit. i, 317,)

Nitrate of potash,	42·55
Sulphate of lime,	25·45
Chlorid of calcium,	0·20
Carbonate of lime,	30·40=98·60.

A vivid deflagration takes place on burning coals, and with combustible substances a strong detonation is produced. It dissolves easily in water, and is not altered by exposure.

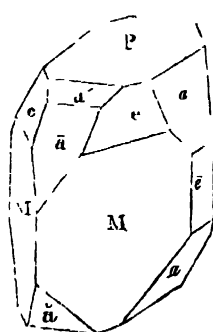
OBS. This salt is found generally in minute needle-form crystals, and crusts, on the surface of the earth, on walls, rocks, &c.

Its most abundant locality is India, where it is obtained in large quantities for the arts. It occurs also in Spain, Hungary, Egypt, Persia, &c. In Madison county, Kentucky, it is found scattered through the loose earth, covering the bottom of a large cave. Other similar caverns in the western states of this country, also contain it.

Nitre is principally employed in the manufacture of gunpowder, of which it constitutes about 75 per cent. In India, it is used for preparing a cooling mixture; an ounce of powdered nitre in five ounces of water, reduces the temperature 15° F.

COPPERAS. VITRIOLUM MARTIALE.

Hemi-prismatic Vitriol-salt, *M.* Green Vitriol. Sulphate of Iron.



Primary form, an acute oblique rhombic prism; M : M=82° 21′, P : M=80° 37′, or 99° 23′. *Secondary form*, e : e=101° 35′, M : ē= 138° 50′. ā : e=140° 48′. *Cleavage* perfect, parallel to P; less so parallel to M. Surface generally smooth. Rare in distinct crystals; generally massive and pulverulent.

H.=2. G.=1·832, of a specimen containing about 0·1 of sulphate of copper. *Lustre* vitreous, both on the natural surface and the surface of fracture. *Streak* white. *Color* various shades of green, passing into white; becomes yellowish on exposure. Subtransparent—translucent. *Taste* sweetish, astringent, and metallic. *Fracture* conchoidal. Brittle.

Composition, Oxyd of iron 25·42, sulphuric acid 29·01, water 45·57 100·00.

The action of the blowpipe renders it magnetic; yields a green glass with borax. It is soluble in twice its weight of water, and the solution is blackened by a tincture of nut galls. When exposed to the air, it becomes covered with a yellow powder, which is the sulphate of the peroxyd of iron.

OBS. This salt usually proceeds from the decomposition of iron pyrites, which readily affords it, if occasionally moistened while exposed to the atmosphere. The old mine of

Rammelsberg, near Goslar, in the Hartz, is its most noted locality: it has also been found in aluminous shale at Hurlet, near Paisley, and in several of the Saxon and Hungarian mines.

It usually accompanies iron pyrites in the United States, and occurs as an efflorescence on the rocks that contain this ore. It is common in coal regions. At Copperas Mt., a few miles east of Bainbridge, Ohio, it occurs with alum and pyrites.

It is employed in the process of dyeing; also in the manufacture of ink and Prussian blue.

COQUIMBITE. Vitriolum hexagonum.

White Copperas. Bisulphated Peroxyd of Iron, *Thom.* Neutrales schwefelsaures Eisenoxyd-Hydrat.

Primary form, a hexagonal prism. The prisms usually have their terminal edges deeply replaced. P : e (a plane replacing the terminal edge; see fig. 125, Pl. II,) =151°, M : e=119°, e : e= 128° 8′. *Cleavage* imperfect, parallel to M. It also occurs in fine granular masses.

Color white; sometimes with a pale violet tint.

Composition, according to M. H. Rose, (Pogg. xxvii, 310,)

Sulphuric acid,	43·55
Peroxyd of iron,	24·11
Water,	30·10
Alumina,	0·92
Lime,	0·73
Magnesia,	0·32
Silica,	0·31=100·04

This salt is wholly soluble in cold water: if the solution be heated, peroxyd of iron is copiously precipitated. Dilute muriatic acid dissolves the whole, except a portion of silica.

Obs. It forms a bed in a felsparry rock, which is supposed to be a fine-grained granite, in the province of Coquimbo, the most northerly part of the republic of Chili, about half a day's journey from Copiapo. This salt is probably derived from the decomposition of iron pyrites. The bed of salt is continually on the increase. Pits twenty feet deep have been formed in it by the people of the country.

YELLOW COPPERAS. Vitriolum parasiticum.

Sulphated Peroxyd of Iron, *Thom.*

In small grains, sometimes consisting of delicate hexagonal tables, too minute for the determination of their angles. Easily cleavable parallel to P.

Lustre pearly. *Color* yellow. Translucent.

Composition, according to H. Rose, (Pogg. xxvii, 314,)

Sulphuric acid,	39·60
Peroxyd of iron,	26·11
Water,	29·67
Magnesia,	2·64
Alumina,	1·95
Silica,	1·37 =101·34

Obs. It is found incrusting the Coquimbite, in the district of Copiapo, a province of Coquimbo.

Other sulphates of iron appear to exist in nature, but are yet little known. Rose obtained for another Coquimbo vitriol, sulphuric acid 31·73, peroxyd of iron 28·11, lime 1·91, magnesia 0·59, water 36·56, silica 1·43=100·53.

The *Pittizite* of Beudant, or vitriol ochre, contains, according to Berzelius, sulphuric acid 15·9, peroxyd of iron 62·4, water 21·7.

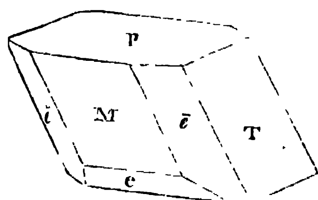
The *Fibro-ferrite* of Prideaux, (Phil. Mag. xviii, 391,) consists of sulphuric acid 26, peroxyd of iron 31, water 33, sulphur, earth, and loss 10=100.

Another, presenting the yellow color and other external characters of the yellow copperas, (Gelbeisenerz,) consists, according to Rammelsberg, (Pogg. xliii, 132,) of sulphuric acid 32·111, peroxyd of iron 46.736, potash 7·882, lime 0·643, water with a trace of ammonia 13·664; or is a compound of sulphate of iron and sulphate of potash—a *Potash Copperas.*

Still another—a *Soda Copperas*, has been analyzed by Scheerer, (Pogg. xlv, 188,) and found to consist of sulphuric acid 32·42, peroxyd of iron 49·37, soda 5·03, water 13·13=99·95.

BLUE VITRIOL. VITRIOLUM CYPRIUM.

Tetarto-prismatic Vitriol-salt, *M.* Sulphate of Copper.



Primary form, an oblique rhomboidal prism; P : M=109° 32′, P : T =127° 40′, M : T=123° 10′. *Cleavage* very imperfect. Occurs also amorphous.

H.=2·25. G.=2·213. *Lustre* vitreous. *Streak* white. *Color* deep sky-blue, of different shades. Subtransparent—translucent. *Taste* metallic and nauseous. Somewhat brittle.

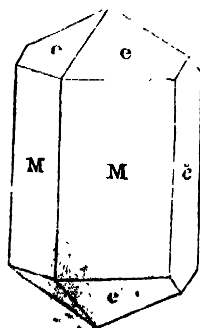
Composition, Sulphuric acid 31·72, oxyd of copper 32·14, water 36·14. It is soluble in water. A polished plate of iron introduced into the solution, becomes covered with copper.

OBS. Blue vitriol is found in waters issuing from mines, and in connection with rocks containing copper pyrites, by the decomposition of which it is formed. Its foreign localities are the Rammelsberg mine, near Goslar in the Hartz, Fahlun in Sweden, also Anglesea, and Wicklow.

When purified, it is employed in dyeing operations, and in the printing of cotton and linen, and for various other purposes in the arts.

WHITE VITRIOL. VITRIOLUM ZINCICUM.

Prismatic Vitriol-salt, *M.* Sulphate of Zinc.



Primary form, right rhombic prism; M : M =90° 42′. *Secondary form*, M : e=129° 2′. M : ĕ=134° 39′. e : e=127° 27′. *Cleavage* perfect parallel to ĕ, or the shorter of the diagonals of the prism.

H.=2—2·5. G.=2·036, as determined by Haidinger. *Lustre* vitreous. *Color* white. Transparent—translucent. Brittle. *Taste* astringent, metallic, and very nauseous.

Composition, when pure, Oxyd of zinc 28.09, sulphuric acid 27·97, water 43·94.

White vitriol froths under the blowpipe, gives off its sulphuric acid, and covers the charcoal with a white coating of oxyd of zinc. It is easily soluble in water.

OBS. This salt is supposed to be formed by the decomposition of blende. It occurs at the Rammelsberg mine in the Hartz, at Schemnitz in Hungary, at Fahlun in Sweden, and at Holywell in Wales. It is of rare occurrence in nature.

It is manufactured for the arts, and is very extensively employed in medicine and dyeing. fine white color, *zinc white*, superior in durability to white lead, is prepared from it.

COBALT VITRIOL. VITRIOLUM COBALTICUM.

Red Vitriol. Sulphate of Cobalt. Kobalt Vitriol.

In stalactites and crusts, investing other minerals. *Lustre* vitreous. *Color* flesh and rose-red. Subtransparent—translucent. Friable. *Taste* astringent.

Composition, according to Kopp, (Gehlen's Jour. 2d series, vi, 157,) Sulphuric acid 19·74, protoxyd of cobalt 38·71, water 41·55. Another cobalt vitriol analyzed by Kopp, gave sulphuric acid 30·4, oxyd of cobalt 28·5, water 41·1; another by Winkelblech, sulphuric acid 29·053, oxyd of cobalt 19·909, water 46·830, magnesia 3·864.

It communicates a blue color to glass of borax.

OBS. It occurs in the rubbish of old mines at Bieber, near Hanau, and also at Leogang in Saltzburg.

JOHANNITE. VITRIOLUM URANICUM.

Hemi-prismatic Euchlore-salt, *M.* Sulphate of the Protoxyd of Uranium, *Thomson.* Uranvitriol.

Primary form, an oblique rhombic prism; crystals flattened and from one to three lines in length, arranged in concentric druses.

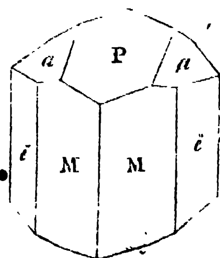
Lustre vitreous. *Streak* yellowish-green. *Color* beautiful emerald-green, sometimes passing into apple-green. Transparent—translucent; sometimes opaque. *Taste* bitter, rather than astringent.

Soluble in water. Solution precipitated chestnut-brown by prussiate of potash, yellowish-green by alkalies, and in brown flocks by an infusion of nutgalls.

OBS. This mineral was discovered by John, in Elias mine, near Joachimstahl, in Bohemia, after whom it is named.

BOTRYOGEN. VITRIOLUM BICOLOR.

Hemi-prismatic Botryogen-salt, *M.* Native Red Iron-Vitriol of Fahlun, *Haid.* Rother Vitriol.



Primary form, an oblique rhombic prism; M : M=119° 56′. *Secondary form*, M : ĕ′=160° 54′, ĕ′ : ĕ′=99° 16′, *a* : *a*=141°. P : *a* =160° 30′. Faces M and ĕ′ striated parallel to the vertical axis. *Cleavage* parallel to M. The crystals are usually small and aggregated in reniform and botryoidal shapes, consisting of globules with a crystalline surface.

H.=2—2·5. G.=2·039. *Lustre* vitreous.

Streak ochre-yellow and a little shining. *Color* deep hyacinth-red; the massive varieties sometimes ochre-yellow. Translucent. *Taste* slightly astringent.

Composition, according to Berzelius, Sulphate of iron 48·3, sulphate of magnesia 20·8, water 30·9.

Under the blowpipe it intumesces and gives off water, producing a reddish-yellow earth, which, by using alternately the reduction and oxydizing flame, is changed into protoxyd or peroxyd of iron. With salt of phosphorus, a red glass is produced, which loses its color on cooling. It remains unaltered if kept dry, but when exposed to a moist atmosphere it becomes covered with a dirty yellowish powder. Boiling water dissolves only a part of it, leaving a yellow ochreous residue.

Obs. The only known locality of this mineral is the famous copper mine of Fahlun, in Sweden, where it coats gypsum or pyrites. The name is derived from βοτρυς, *a bunch of grapes*.

GLAUBERITE. GÆALUM OBLIQUUM.

Hemi-prismatic Brithyne-Salt, *Haid.* Brongniartin, *v. Leonh*; *Brongniart*, J. des Mines, xxiii, 5.

Primary form, an acute oblique rhombic prism; M : M=83° 20′, P : M=101° 15′; 104° 11′ (crystal from Vic) Dufrénoy. *Secondary forms*, similar to fig. 101, Pl. II; another variety has the front lateral edge *ē* truncated; P : *ē*=137° 9′, *ē* : *ē*=116° 20′, M : *ē* =131° 40′. *Cleavage* perfect parallel to P.

H.=2·5—3. G.=2·75—2·85. *Lustre* vitreous. *Streak* white. *Color* pale-yellow or gray. *Fracture* conchoidal; brittle. *Taste* slightly saline.

Composition, Sulphate of lime, 49·003, and sulphate of soda 50·997. Immersed in water it loses its transparency, and is partly dissolved. On long exposure it absorbs moisture and falls to pieces. Under the action of the blowpipe it decrepitates and melts to a clear glass. If insulated, resinous electricity may be excited by friction.

Obs. It occurs in crystals in rock salt at Villa Rubia, near Ocana, in New Castile; also at Aussee, in Upper Austria, and at the salt mines of Vic, in France.

POLYHALITE. GÆALUM COLUMNARE.

Prismatic Brithyne-Salt. *M.* Bloedite, *John.*

Primary form, a right rhombic prism; M : M=115°. It seldom occurs distinctly crystallized, but usually in fibrous masses.

H.=2·5—3. G.=2.7689. *Lustre* resinous, or slightly pearly. *Streak* red. *Color* flesh or brick-red, sometimes yellowish. Translucent—opaque. *Taste* bitter and astringent, but very weak.

Composition, according to Stromeyer,

	Ischel.
Sulphate of lime,	44·7429
Sulphate of potash,	27·7037
Sulphate of magnesia,	20·0347
Chlorid of sodium,	0·1910
Peroxyd of iron,	0·3376
Water,	5·9535=98·9434

According to Berthier (Ann. des M. x, 260) three varieties from Vic consist as follows:

	Crystallized.	Red massive.	Gray massive.
Sulphate of lime,	40·0	45·0	40·0
Sulphate of soda,	37·6	44·6	29·4
Chlorid of sodium,	15·4	6·4	0·7
Sulphate of magnesia,			17·6
Sulphate of manganese,	0·5		—
Alumina and oxyd of iron,	4·5	3·0	4·3
Loss,	2·0	1·0	8·0

Becomes opaque in the flame of a candle, and of a brownish color. Before the blowpipe it fuses instantaneously: It is but slightly soluble in water.

Obs. The mines of Ischel and Aussee, in Salzburg, where it occurs with common salt, gypsum, and anhydrite, and the salt mines of Vic, in Lorraine, are the principal localities of this mineral.

The name Polyhalite is derived from πολύς, *many*, and ἅλς, *salt*, in allusion to the number of salts in its constitution.

CLASS II.

ORDER I. HALINEA.

OXALATE OF IRON. Astasialus phytogeneus.

Mariano de Rivero, Ann. de Ch. et de Ph. xviii, 207. Humboldtine. Eisen Resin, *Breithaupt*. Oxalite.

Earthy; crystallization undetermined.

G.=2·13—2·489. Soft; may be scratched by the nail. Dull. *Color* yellow. *Fracture* uneven, earthy. Acquires negative electricity by friction, when insulated.

Composition, according to Mariano de Rivero, Oxalic acid 46·14, and protoxyd of iron 53·86; according to Rammelsberg, (Pogg. liii, 631, 1841,) protoxyd of iron 41·40, oxalic acid 42·69, and water 15·91=100.

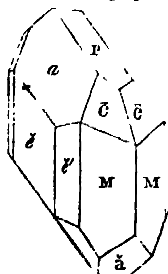
It blackens instantly in the flame of a candle, and is then attractable by the magnet. A continuance of the heat brings out a vegetable odor, and soon causes decomposition, leaving a stain, at first yellow, then black, and finally red.

Obs. It occurs at Koloseruk, in Bohemia, and, in the opinion of Rivero, has resulted from the decomposition of succulent plants.

OXALATE OF LIME.

H. T. Brooke, Phil. Mag. xvi, 449.

Primary form, an oblique rhombic prism; M : M=100° 36′, P : M=103° 14′. *Secondary*, the annexed figure; P : *a*=127° 25′, P : ă=109° 28′, P : ē=143° 4′, M : č=129° 42′. *Cleavage* parallel with P; also more imperfect parallel with M, and the longer diagonal. All the planes bright except M and ē, which are vertically striated. Twin crystals occur compounded parallel with the plane ă.



H.=2·5—2·75. *Lustre* like sulphate of lead. Very brittle. *Fracture* conchoidal.

Obs. This species was observed by Brooke in crystals from a tenth to a fourth of an inch on calc spar; but the locality of the spar is not known.

MELLITE. MELLIS PYRAMIDALIS.

Pyramidal Mellichrone-Resin, *M*. Mellilite. Honey Stone. Mellate of Alumina. Honingstein, *of the Germans*.

Primary form, a square octahedron; A : A=118° 4′. *Secondary form*, similar to fig. 55, Pl. I, also with the terminal or lateral solid angles truncated. *Cleavage* very indistinct, parallel with the primary faces. Occurs also in massive nodules.

H.=2—2·5. G.=1·55—1·597. *Lustre* resinous, inclining to vitreous. *Streak* white. *Color* honey-yellow, often reddish or brownish. Transparent—translucent. *Fracture* conchoidal. Sectile.

Composition, according to Klaproth, (Beit. iii, 16,) and Wöhler, (Pogg. vii, 325,)

Alumina,	16	14·5
Mellic acid,	46	41·4
Water,	38=100, K.	44·1=100, W.

In the flame of a candle it whitens, but does not take fire. It dissolves in nitric acid, and is decomposed by boiling water.

OBS. Astern, in Thuringia, is the only known locality of Mellite. It there occurs in a bed of earthy-brown coal, and is occasionally accompanied with small crystals of sulphur.

CRYOLITE. CRYALUS FUSILIS.

Prismatic Cyrone-Haloid, *M*. Alumine Fluatée Alcaline, *H*.

Primary form, a right rectangular prism. *Cleavage*, basal, perfect; lateral, less so. Occurs in lamellar masses.

H.=2·25—2·5. G.=2·949. *Lustre* vitreous; slightly pearly on P. *Streak* white. *Color* white; sometimes reddish or brownish. Subtransparent—translucent. Immersion in water increases its transparency. Brittle.

Composition, according to Berzelius, (K. V. Ac. H. 1823, p. 315,) Alumina 24·4, soda 31·35, and hydrofluoric acid 44·25. It is fusible in the flame of a candle, and hence its name, from κρυος, *ice*. Before the blowpipe, it first fuses, then becomes hard, white, and opaque, and ultimately assumes a slaggy appearance.

OBS. Arksutfiord, in West Greenland, is the only known locality of this mineral. It was discovered by Giesècké, in two veins in gneiss, associated with galena, pyrites, and spathic iron. Specimens may be obtained there from six inches to a foot in diameter.

WEBSTERITE. ALUMINUS TERRENUS.

Aluminite. Hallite. Trisulphate of Alumina, *Thomson*.

Reniform, massive; impalpable.

H.=1·5—2. Yields to the nail. G.=1·6606. *Lustre* dull, earthy. *Streak* white, little glimmering. *Color* white. Opaque. *Fracture* earthy. Adheres to the tongue, and is meagre to the touch.

Composition, according to Stromeyer, (Untersuchungen, p. 99,)

Sulphuric acid,	23·370	23·365
Alumina,	29·868	30·263
Water,	46·762=100	46·372=100

Fuses with difficulty. Easily soluble in acids without effervescence. Absorbs water, but does not fall to pieces.

Obs. It occurs at Newhaven, Sussex, in reniform and botryoidal concretions, imbedded in ferruginous clay, which rests on the chalk strata; also under similar circumstances at Epernay in France, and in plastic clay at Hallé on the Saale in Prussia.

PISSOPHANE.

Pissophan, *Breithaupt*.

Amorphous.

H.=1·5. G.=1·93—1·98. *Lustre* vitreous. *Color* pistachio, asparagus or olive-green. Transparent. Very fragile. *Fracture* conchoidal.

Composition, according to Erdmann, (Schweig. J. lxii, 104,) Sulphuric acid 12·593, alumina 35·228, peroxyd of iron 9·769, water 41·605.

Insoluble in water. Easily soluble in muriatic acid. Becomes black before the blowpipe. In a glass tube gives alkaline water.

Obs. Occurs at Garnsdorf, near Saalfield.

ALUM STONE. Aluminus rhombohedrus.

Rhombohedral Alum Haloide, *M*. Alunit. Alaunstein. Alumine Sous sulfatée Alkaline, *H*.

Primary form, an obtuse rhombohedron; R : R=92° 50′. *Secondary form*, fig. 113, Pl. II. *Cleavage*, basal, nearly perfect; rhombohedral, indistinct. Also massive, having a granular or impalpable texture.

H.=5. G.=2·58—2·752. *Lustre* vitreous on R, inclining to pearly on a. *Streak* white. *Color* white, sometimes grayish or reddish. Transparent—subtranslucent. *Fracture* flat, conchoidal, uneven; of massive varieties, splintery, and sometimes earthy. Brittle.

Composition, according to Cordier (Ann. de M. iv, 205, and v, 203) and Vauquelin,

	From Mount d'Or, in Auvergne.	From Tolfa.
Sulphuric acid,	27·03	25·00
Alumina,	31·80	43·92
Silica,	28·40	24·00
Potash,	5·79	3·08
Water and loss,	3·72	4·00
Protoxyd of iron,	1·44=98·18, C.	——=100, V.

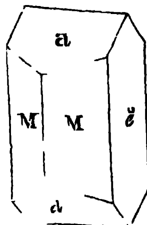
It decrepitates in the blowpipe flame, and is infusible both alone and with soda. With borax, it forms a colorless globule. When pulverized, it is soluble in sulphuric acid.

Obs. This mineral is met with in crystals at Tolfa, near Civita Vecchia, in the neighborhood of Rome; also at Beregh in Hungary. It occurs only in volcanic rocks. The compact varieties from Hungary are so hard, as to admit of being used for millstones. Alum is obtained from it by repeatedly roasting and lixiviating, and, finally, crystallizing by evaporation.

WAVELLITE. ASTRAIUS RHOMBICUS.

Prismatic Wavelline-Haloide, *Haid.* Subphosphate of Alumine. Devonite. Hydrargyrite. Lasionite, *Fuchs.*

Primary form, a right rhombic prism; M : M = 122° 15′. *Secondary form*, a . a (adjacent planes) = 107° 26′, M : $\bar{e}$ = 118° 53′. *Cleavage* perfect parallel to M, and also to $\bar{e}$ or the longer diagonal. Usually in hemispherical or globular concretions, having a radiated structure internally.



H = 3·25—4. G = 2·337, (Barnstaple,) Haidinger, 2·3616, (Irish variety,) Richardson. *Lustre* vitreous, inclining to pearly and resinous. *Streak* white. *Color* white, passing into yellow, green gray, brown, and black. Translucent.

Composition, according to Fuchs and Berzelius,

Alumina,	37·20	35·35
Phosphoric acid,	35·12	33·40
Water,	28·00	26·80
Fluoric acid,	——	2·06
Lime,	——	0·50
Oxyd of iron and manganese,	——100·32, F.	1·25—99·36, B.

Becomes white under the blowpipe, losing its translucency, but is infusible. With boracic acid and iron wire it affords a globule of phosphuret of iron. Reduced to powder, it dissolves in hot nitric or sulphuric acid, giving off a vapor which corrodes glass.

OBS. Wavellite was first discovered in a tender clay slate near Barnstaple, in Devonshire, by Dr. Wavell. It has since been found at Clonmell, near Cork, in the Shiant isles of Scotland, at Zbirow in Bohemia, on brown iron ore at Amberg in Bavaria, (a variety called *Lasionite*, by Fuchs.)

In the United States Wavellite has been found near Saxton's River, Bellows Falls, N. H.

CACOXENE. ASTRAIUS FERRIFERUS.

Kakoxene, *Steinmann.* Variety of Klaprothine, *Beudant.*

Occurs in radiating tufts, of a silky lustre.

H = 3—4. G = 3·38. *Color* yellow or yellowish-brown; becoming brown on exposure.

Composition according to Steinmann, (Leonh. Orykt. s. 750,) Holger, (Baumg. Zeitsch. viii, 129,) and Richardson, (Thomson's Min. i, 476,)

Alumina,	10·01	11·29	——
Peroxyd of iron,	36·32	36·83	43·1
Phosphoric acid,	17·86	9·20	20·5
Silica,	8·90	3·30	2·1
Lime,	0·15	——	1·1
Magnesia,	——	7·58	0·9
Oxyd of tin,	——	1·23	——
Sulphuric acid,	——	11·29	——
Water and fluoric acid,	25·95	18·98	30·2
	99·19. S.	99·70. H.	97·9, R.

Alone before the blowpipe, unaltered except that it becomes dark reddish-brown. With

borax, fuses readily to a dark red bead, transparent in the outer flame, but yellowish in the inner.

Obs. Occurs at Hrbeck in Bohemia, in brown iron ore.

In the United States it forms tufts and coatings along with specular iron and quartz at the Sterling iron mine, Antwerp, Jefferson Co., N. Y. Inferior specimens are found with red oxyd of iron, at Mt. Defiance, near Ticonderoga, N. Y.

Cacoxene is considered by Rammelsberg, Wavellite, with part of the alumina replaced by oxyd of iron. It resembles Carpholite, which is found in similar situations, but differs in its deeper color. The name Cacoxene is derived from κακος, *bad*, and ξενος, *guest*, because its phosphoric acid is injurious to the iron.

FLUELLITE. Fluellus pyramidalis.

Levy, Ed. J. of Sc. 1825, p. 178. Fluate of Alumine. Fluorid of Aluminium.

Primary form, a right rhombic prism; M : M=105° nearly. It commonly appears under the form of an acute rhombic octahedron, fig. 76, Pl. II, in which a : a=109°.

H.=3. *Color* white. Transparent.

Contains fluoric acid and alumina, according to an imperfect analysis by Wollaston.

Obs. Fluellite is an extremely rare mineral, and was first discovered by Levy. The few specimens that have been obtained, were found at Stenna-gwyn, in Cornwall, with Wavellite and uranite, in minute crystals, on quartz.

WAGNERITE. Fluellus obliquus.

Hemi-prismatic Fluor Haloide, *Haid.* Wagnerit, *Fuchs.* Fluophosphate of Magnesia, *Thom.*

Primary form, an oblique rhombic prism; M : M=95° 25′. P : M=109° 20′. Most of the prismatic planes are deeply striated.

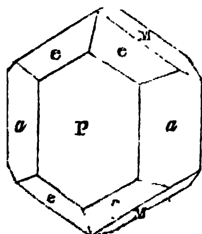
H.=5—5·5. G.=3·11. *Lustre* vitreous. *Streak* white. *Color* yellow, of different shades; often grayish. Translucent. *Fracture* uneven and splintery across the prism.

Composition, according to Fuchs, Phosphoric acid 41·73, hydrofluoric acid 6·50, magnesia 46·66, oxyd of iron 5, oxyd of manganese 0·5. It fuses with difficulty, alone, before the blowpipe, to a dark greenish-gray glass: with borax or biphosphate of soda, it is readily dissolved and forms a colorless pearl. Nitric or sulphuric acid gently heated, evolves from its powder fumes of fluoric acid.

Obs. This rare species occurs in the valley of Holgraben, near Werfen, in Saltzburg, in irregular veins of quartz, traversing clay slate.

HERDERITE. Fluellus rhombicus.

Herderite, Prismatic Fluor-Haloide, *Haid.* Ann. of Phil. 1828, iv, 1. Allogonite, *Breit.*



Primary form, a right rhombic prism; M : M=115° 53′. *Secondary form*; P : a=147° 34′, *a* : *a* (adjacent planes) =64° 51′, e : e=141° 17′, M : e=128° 40′, P : e=141° 20′. *Cleavage* interrupted parallel to M, also traces parallel to P. Surfaces M and e very smooth, and delicately marked with lines parallel to the edge of intersection.

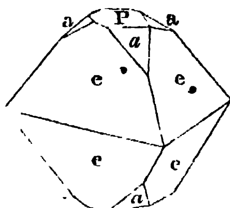
H.=5. G.=2·985. *Lustre* vitreous, inclining to subresinous. *Streak* white. *Color* various shades of

yellowish and greenish-white. Translucent. *Fracture* small conchoidal. Very brittle.

OBS. The only specimen of this mineral as yet found, was obtained at the tin mines of Ehrenfriedersdorf, in Saxony, imbedded in fluor spar. It much resembles the asparagus variety of apatite, for which it was mistaken till proved to be a distinct species by Haidinger, who gave it the above name in compliment to Baron Von Herder, the director of the Saxon mines.

CHILDRENITE. FLUELLUS CHILDRENIANUS.

Brooke, Quarterly Jour. of Sci. xvi, 274.



Primary form, trimetric. *Secondary form*, e : e (adjacent planes in the same pyramid) =97° 50′ and 102° 30′, e : e (different pyramids) =130° 20′, a : a=124° 54′. *Cleavage* imperfect, parallel with P.

H.=4·5—5. *Lustre* vitreous, inclining to resinous. *Streak* white. *Color* yellow and pale yellowish-brown, also yellowish-white. Translucent. *Fracture* uneven.

Consists, according to Wollaston, of Phosphoric acid, alumina, and iron.

OBS. Occurs in minute crystals and crystalline coats, on spathic iron or quartz, near Lavistock, in Devonshire. It was discovered by Levy, and named in honor of Mr. Children.

LEUCOPHANE. FLUELLUS TRICLINATUS.

Leucophane, *Esmark*, *Tamnau*, Berz. Jahresbericht, xx. and xxi.

Crystalline form triclinate? a four-sided prism. M : T=106° 50′, and 72° 52′. *Cleavage* imperfect in three directions. Seldom regularly crystallized.

H=3·5—3·75. G.=2·974. *Lustre* vitreous on cleavage surface. *Powder* white. *Color* pale dirty green to deep wine-yellow. Thin fragments transparent and colorless. Powder phosphorescent. Electric when heated.

Composition, according to Erdmann, (K. V. Ac. H. 1840,) Silica 47·82, glucina 11·51, lime 25·00, protoxyd of manganese 1·01, potassium 0·26, sodium 7·59, fluorine 6·17.

Fuses before the blowpipe to a clear violet glass, which becomes clouded in cooling. With borax it fuses easily to an amethystine glass. Affords fluosilicic acid with salt of phosphorus in a glass tube.

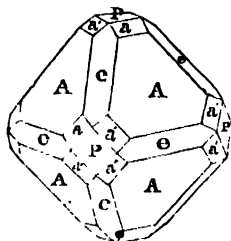
OBS. Leucophane occurs in syenite with albite, elæolite, and yttrotantalite, on a small rocky islet near the mouth of the Langesundfiord in Norway, where it was found by Esmark. It resembles somewhat a light green variety of apatite.

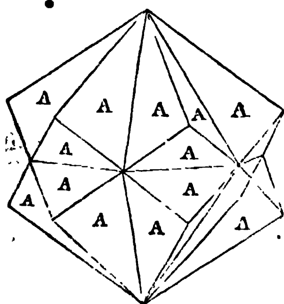
The name leucophane is from λευκος, *white*, and φαινω, *to appear*.

FLUOR SPAR. FLUELLUS OCTAH

Octahedral Fluor-Haloide, *M.* Fluate of Lime. Fluorid of Calcium. Ratoffkit. Chlorophane. Chaux Fluatée, *H.* Muria Phosphorans, *Linn.*

Primary form, the regular octahedron, fig. 4, Pl. I. *Secondary forms:* the most common is the cube, fig. 1, Pl. II. Others are represented in figures 2, 3, 5, 6, 7, 9, 10, 11, 14, 16, 24, and 25, of the same plate. These simple forms also occur in combination; the annexed figure is one of its secondaries. *Cleavage* octahedral, perfect. *Compound crystals,* fig. 129, Pl. II; also the annexed figure, which is an instance of the same kind of composition; but the individuals are continued beyond the face of composition, and one is partially enveloped by the other. *Imperfect crystallizations:* structure rarely columnar; often granular, coarse or fine.





H.=4. G=3·14—3·178. *Lustre* vitreous; sometimes splendent; usually glimmering in the massive varieties. *Streak* white. *Colors* white, yellow, green, rose and crimson-red, violet-blue, sky-blue, and brown. Wine-yellow, greenish and violet-blue, are the most common colors; the red varieties are the rarest. The colors of massive varieties are often arranged in concentric layers. Transparent—subtranslucent. Brittle. *Fracture* of fine massive varieties, flat conchoidal and splintery.

Composition, Fluorine 47·73, and calcium 52·27.

Below a red heat, the coarsely pulverized spar becomes vividly phosphorescent. The colors of the light thus produced are various, and are independent of the external color. The variety *chlorophane* emits a bright emerald-green light. At a high temperature, phosphorescence ceases, but it is partially restored by an electric discharge, (§ 94.) Before the blowpipe, fluor spar decrepitates, and ultimately fuses into an enamel. If the flame be continued, the fluorine is in part expelled, and the specimen assumes a cauliflower appearance.

OBS. Fluor spar seldom occurs in beds, but generally in veins, intersecting gneiss, mica slate, clay slate, and also several secondary rocks. In the north of England, it is the gangue of the lead mines, which intersect the coal formations of Northumberland, Cumberland, Durham, and Yorkshire. In Derbyshire, it is abundant; and also in Cornwall, where the veins intersect much older rocks. It is a common mineral in the mining districts of Saxony.

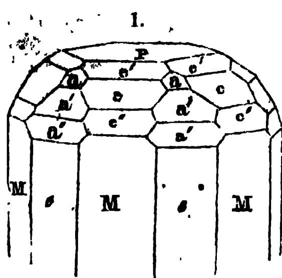
The most remarkable locality of fluor spar in the United States, was lately found on the borders of Muscalonge lake, in Jefferson county, New York, where it occurs in primitive limestone. Cubical crystals of an enormous size, some more than a foot in their dimensions, have been obtained at this place. The spar of this region has usually a greenish tinge. Rossie and Johnsburgh, St. Lawrence Co., have afforded some fine crystals of fluor. In Gallatin Co., Illinois, for 30 miles along the Ohio, in the region southwest of Cone's Rock, at Shawneetown, and other places, a dark purple fluor, often in large and beautiful crystals, occurs scattered through the soil, or imbedded in limestone. At the north village of Westmoreland, N. H., two miles south of the meeting house, fluor spar occurs of white,

green, and purple shades, constituting a vein with quartz; also at the Notch in the White Mountains, green octahedrons have been found in a crystalline quartz. Some fine veins have been discovered on Long Island, Blue Hill Bay, Maine. It also occurs sparingly of a green color at Putney, Vt.; in Shenandoah county, Virginia, near Woodstock, in the fissures of a limestone; on the Potomac, at Shepardstown, in white limestone; in Smith county, Tennessee, in white and purple cubes; at Lockport, New York, in white cubes with celestine in limestone; in fine cubes near Rochester and Manlius in limestone; at Amity, New York, in thin seams with spinel and tourmaline; at the Southampton lead mine in Massachusetts; and near the Franklin furnace, New Jersey.

The variety chlorophane forms two veins in gneiss, each about 18 inches wide, in the town of Trumbull, Connecticut, along with topaz and magnetic pyrites.

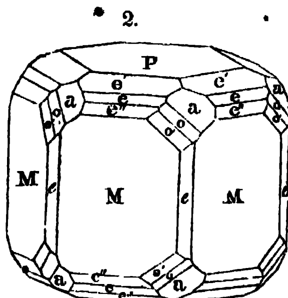
APATITE. Fluellus hexagonus.

Rhombohedral Fluor-Haloide, *M.* Phosphate of Lime. Spargelstein, Phosphorit, *W.* Asparagus stone. Moroxite. Chrysolite. Eupyrchroite, *Emmons.* Augustite. Pseudo-apatite, *Breit.*

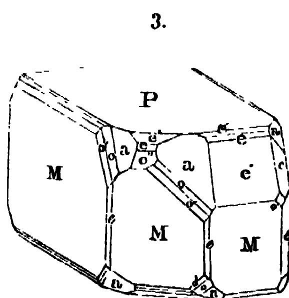


Primary form, a hexagonal prism, fig. 114, Pl. II. *Secondary forms:* fig. 125, Pl. II, also the annexed figures: fig. 3 is a distorted form of fig. 2.

P : e=139° 48′, P : c′=157° 6′, P : e″=120° 36′, M : e=130° 12′, M : e′=112° 54′, M : e″=149° 24′, P : a=143° 48′, P : a′=124° 20′, P : a″=108° 51′, *e* : a=126° 12′, *e* : a′=145° 40′, *e* : a″=161° 9′. *Cleavage* imperfect, parallel both to P and M. *Im-*



St. Gothard.



St. Gothard.

perfect crystallizations: globular and reniform shapes; structure fibrous, or imperfectly columnar; massive, structure granular.

H.=5, sometimes 4·5. G.=3—3·225. *Lustre* vitreous, inclining to subresinous. *Streak* white. *Color* usually sea-green, bluish-green, or violet-blue; sometimes white; also occasionally yellow, gray, red, and brown; none bright. Transparent—opaque. A bluish opalescence is observed in the direction of the vertical axis in some specimens, especially in the white varieties. Cross *fracture* conchoidal and uneven. Brittle. Some varieties are *phosphorescent* when heated, particularly those crystals which are but slightly modified at their extremities; others become electric by friction.

Composition, according to G. Rose, (Pogg. ix,)

	Snorum, Norway.	Cabo de Gata, Spain.	Arendal, Norway.	Greiner, Tyrol.	St. Gothard, Tyrol.
Chlorid of Calcium,	4·28	0·885	0·801	0·15	a trace.
Fluorid of Calcium,	4·59	7·049	7·01	7·69	7·69
Subsesquiphosphate of Lime,	91·13	92·066	92·189	92·16	92·31
	G. =3·174	G.=3·235	G.=3·191	G=3·175	G.=3·197

Infusible alone before the blowpipe except on the edges. With biphosphate of soda or borax, it fuses without difficulty to a glass, which, on cooling, has a crystalline structure. It also fuses if mixed with carbonate of iron. It dissolves slowly in nitric acid, and without effervescence.

Obs. Apatite usually occurs in primitive formations. It is often found in veins in gneiss or mica slate, and particularly those containing tin and iron ore; also, in primitive limestone. It is sometimes met with in serpentine, and occasionally, as in Spain, in ancient volcanic rocks.

Its principal foreign localities are Ehrenfriedersdorf in Saxony; Slackenwald in Bohemia; Caldbeck Fell in Cumberland, Devonshire; St. Gothard in Switzerland. The greenish-blue variety, called *moroxite*, occurs at Arendal in Norway.

The *asparagus stone* or *spargelstein* variety, which is obtained at Zillerthal in the Tyrol, is translucent and has a wine-yellow color; it is imbedded in talc. The *phosphorite* or massive varieties are mostly obtained from Estremadura in Spain, and Slackenwald in Bohemia.

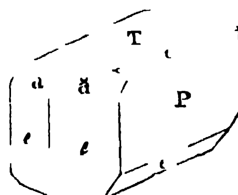
Magnificent crystals of apatite are found in St. Lawrence Co., N. Y., in white limestone, along with scapolite, sphene, &c. One crystal was obtained from Robinson's farm, in the town of Hammond, which measured nearly a foot in length, and weighed 18 pounds. Smaller crystals are very abundant, and the prisms are frequently well terminated. Besides the locality in Hammond, fine crystals are obtained about a mile southeast of Gouverneur, in a similar gangue, and also in the town of Rossie, with sphene and pyroxene, two miles north of the village of Oxbow. Other localities of importance in New York are as follow: bank of Vrooman lake, Jefferson Co., in white limestone, fine green prisms from half to five inches long; Sanford mine, East Moriah, Essex Co., in magnetic iron ore, which is often thickly studded with six-sided prisms: also at Long Pond, Essex Co.; near Edenville, Orange Co., in prisms from half an inch to 12 inches long, of a bright asparagus-green color, imbedded in white limestone; and in the same region, blue, grayish-green and grayish-white crystals: two miles south of Amity, emerald and bluish-green crystals; and at Long Pond, Essex Co., with garnet and idocrase. Greenfield, Saratoga Co., St. Anthony's Nose, and Corlaer's Hook, are less interesting localities. A fibrous mammillated variety (*Eupychroite*) occurs at Crown Point, Essex Co., about a mile south of Hammondsville. In *New Hampshire*, crystals, often of very large size, occur abundantly in the south part of Westmoreland, four miles south of the north village meeting house, occupying a vein of feldspar and quartz in mica slate, along with molybdenite. Some fine crystals have been found at Piermont, N. H., in white limestone, on the land of Mr. Thomas Cross. In *Maine*, on Long Island, Blue-hill Bay, apatite occurs in veins 10 inches wide, intersecting granite. In *Massachusetts*, fine crystals of apatite, occasionally six inches long, are obtained at Norwich, (northwest part,) in gray quartz. At Bolton it is abundant, but the forms are seldom interesting. Chesterfield, Chester, Sturbridge, Hinsdale, and Williamsburgh, have afforded some crystals. Apatite has also been found near Baltimore, Maryland; at Dixon's quarry, Wilmington, Delaware, of a rich blue color; in Bucks Co., Pennsylvania, three miles west of Attleboro'; on the Morris canal, near Suckasung, N.J., of a brown color, in massive magnetic pyrites.

Apatite was named by Werner from *απαταω, to deceive*, in allusion to the mistake of the older mineralogists, with regard to the nature of its many varieties.

The *Pseudoapatite* of Breithaupt is considered by Rammelsberg an earthy variety of apatite.

PHARMACOLITE PHARMACALUS STELLATUS

Hemi-prismatic Euclase Haloide, *Haid* Brewster's Ed J, 1822 iii 302 Arsenate of Lime Arsenic bluth, *Werner* Picro pharmacolite



Primary form, a right rhomboidal prism M · T=96° 46′. *Secondary form*, e · e=117° 24′; P e=121° 18′. *Cleavage* parallel to T, eminent The crystals are usually lengthened in the direction of P, and often one face e is obliterated by the extension of the other. The surfaces T and e are usually striated parallel to their mutual intersection Rarely in distinct crystals, commonly in delicate silky fibres or acicular crystallizations, aggregated in stellated groups. Also botryoidal and stalactitic, and sometimes impalpable.

H.=2—2 5 G =2 64—2 73 *Lustre* vitreous, except on P, on which it inclines to pearly. *Streak* white *Color* white or grayish, frequently tinged red by the arsenate of cobalt which often accompanies it Translucent—opaque *Fracture* uneven

Composition according to Klaproth, (of a specimen from Wittichen) (Beit iii 277) Lime 25 arsenic acid 50 54 water 24 46 John's analysis of a specimen from Andreasberg, gives lime 27 28 arsenic acid 45 68 water 23 86 Pure specimen from Mr Ferguson's collection were analyzed by Dr Turner, (Brewster's J iii 306) and found to contain arsenate of lime 79 01 and water 20 99 Exposed to the blowpipe it is almost entirely volatilized and gives off dense white fumes of arsenic It dissolves readily in nitric acid without effervescen

Obs Crystals of pharmacolite have been found in the grand duchy of Baden also in botryoidal or globular groups of delicate white silky crystals at St Marie aux Mines in the Vosges at Andreasberg in the Hartz and at Riegelsdorf in Hessia at Wittichen near Fürstenberg in Germany it occurs in acicular crystals associated with cobalt and disseminated on granite

This species was named in allusion to its containing arsenic from φάρμακον poison

MAGNESIAN PHARMACOLITE PHARMACALUS MAGNESIFERUS

Berzelite, *Kühn* Ann Ch Pharm xxxiv, 211

Massive, with a foliated cleavage in one direction

H =5—6 G =2 52 *Lustre* waxy. *Color* dirty white or honey-yellow Brittle.

Composition, according to Kuhn

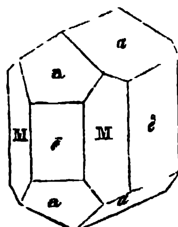
Lime 23 22, magnesia 15 68 protoxyd of manganese 2 13 arsenic acid 58 52, iron a *trace*, loss by ignition 0 30—99 85

Acts before the blowpipe like pharmacolite

Obs Occurs at Langbanshyttan in Wermeland with an ore of iron and granular bitter spar This mineral was called Berzelite by Kuhn, in honor of Berzelius, but this name is already appropriated to another mineral A Pharmacolite from Riegelsdorf, containing 3 per cent of magnesia, (Stromeyer, Untersuchungen, p 135,) has been called *picropharmacolite*

HAIDINGERITE. PHARMACALUS RHOMBICUS.

Prismatic Euclase-Haloid, *M.* Diatomous Gypsum-Haloide, *Haid.* Brewster's Journal, iii, 308. Haidingerite, *Turner.*



Primary form, a right rhombic prism; M : M=100°. *Secondary form*, M : ĕ=140°, M : ĕ =130, *a* : *a* (adjacent planes,)=126° 58′ ĕ : a= 116° 31′. *Cleavage* highly perfect and easily obtained, parallel to ĕ.

H.=1·5—2·5. G.=2·848. *Lustre* vitreous. *Streak* white. *Color* white. Transparent—translucent. Sectile; thin laminæ slightly flexible.

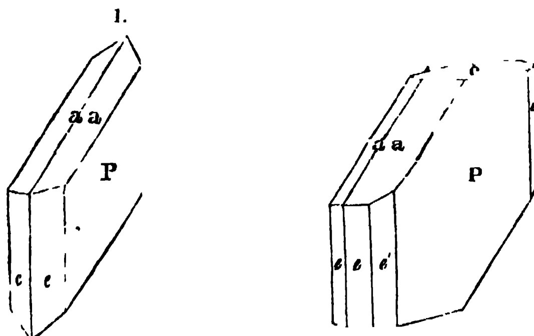
Composition, according to Turner, (Brewster's Jour. iii, 308,) Arseniate of lime 85·681, and water 14·319. Dissolves easily in nitric acid.

OBS. This mineral was first distinguished as a species by Mr. Haidinger. A single specimen only has been obtained from its locality at Baden. It is associated with pharmacolite, of which it was supposed to be a variety; it occurs mostly in minute crystals, aggregated into botryoidal forms.

GYPSUM. GYPSALUS RHOMBOIDEUS.

Prismatoidal Euclase Haloide, *M.* Sulphate of Lime. Alabaster. Selenite. Gypseus vulgaris, *Cartheuser.* Γύψος.

Primary form, a right rhomboidal prism; M : T=113° 18′. *Secondary forms:*



Poland, Ohio.

P : a=110° 33′, a : a=138° 54′, P : *e*=124° 42′, P : *e′*=144° 9′. *Cleavage* highly eminent, parallel to P; parallel to M much less perfect, parallel to T obtained with difficulty, on account of the flexibility of the mineral in this direction. *Compound crystals:* composition of the *first kind* parallel to each of the three primary faces; of the *second kind*, parallel with a plane truncating the edge a : a; of the *third kind*, parallel with a. The arrow-shaped crystals result from a composition parallel to T. *Imperfect crystallizations:*

stellated aggregations, composed of sublamellar particles; also lamellar and granular: sometimes nearly impalpable.

H.=1·5—2. G.=2·31—2·3257. *Lustre* of P pearly and shining, of M and T vitreous. Massive varieties have often a glistening lustre, and sometimes are dull and earthy. *Streak* white. *Color* usually white, sometimes gray, flesh-red, honey-yellow, ochre-yellow, and blue: impure varieties are often black, brown, red, or reddish-brown. Transparent—opaque. Brittle parallel to M.

Composition, Sulphuric acid, 46·31, lime 32·90, and water 20·79. Before the blowpipe, it becomes opaque-white, exfoliates, and falls to a powder. At a high heat it fuses with difficulty to a white enamel. The white powder obtained by heat, if moistened, soon becomes very firmly solid. It does not effervesce with acids when pure.

Obs. The transparent varieties have been distinguished by the name *Selenite;* and the fine massive varieties are called *Alabaster*. Gypsum often forms very extensive beds in secondary countries, and is also found in tertiary deposits; occasionally in primitive rocks. It is also a product of volcanoes.

The finest foreign specimens are found in the salt mines of Bex, in Switzerland; at Hall, in the Tyrol; in the sulphur mines of Sicily; in the gypsum formation, near Ocana, in Spain; and in the clay of Shotover Hill, near Oxford. Large lenticular crystals have been met with at Montmartre, near Paris. Derbyshire affords the fibrous varieties. Alabaster occurs near Sienna, in Tuscany; it is transported from this place to Florence, and employed for the manufacture of vases, figures, &c. Gypsum also occurs in acicular crystals covering lavas in most volcanic regions.

This species occurs in extensive beds in several of the United States; and more particularly New York, Ohio, Illinois, Virginia, Tennessee, and Arkansas, and is usually associated with salt springs.

Fine specimens of selenite and snowy gypsum occur in New York, near Lockport, in limestone along with pearl spar and anhydrite; also near Camillus, Onondaga County, and occasional crystals are met with in the vicinity of Manlius. In Ohio, large transparent crystals (fig. 1) have been found at Poland and Canfield, Trumbull County: in Maryland, large grouped crystals on the St. Marys, in clay; also near the mouth of the Patuxent. Selenite and alabaster occur in Davidson County, Tennessee, and large beds of gypsum with rock salt in Washington County, Virginia, eighteen miles from Abingdon. In the Mammoth Cave, Kentucky, it presents singular imitations of vines, flowers, and shrubbery, (see § 42.)

Pseudomorphs of gypsum have been observed in cubes, imitative of rock salt, and in rhombohedrons imitative of dolomite, (Haidinger, Pogg. lii, 622, 1841.)

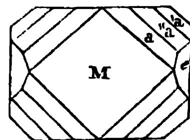
Plaster of Paris is gypsum which has been heated and ground up. It is used for making moulds, taking casts of statues, medals, &c., for producing a hard finish on walls; also in the manufacture of artificial marbles, as the scagliola tables of Leghorn. Gypsum is also employed for improving lands. The uses of alabaster are well known.

The fibrous variety when cut *en cabochon*, and polished, reflects light similarly to cat's eye.

This mineral is easily distinguished from mica by its inferior hardness and want of elasticity, and by a less easy cleavage; and, in general, its softness will distinguish it from the minerals it most resembles.

ANHYDRITE. Gypsalus rectangulus.

Prismatic Orthoklas-Haloid, *M.* Cube Spar, Muriacite, *W.* Karstenite, *Haus.* Vulpinite. Anhydrous Sulphate of Lime.



Primary form, a right rectangular prism. *Secondary form*, similar to fig. 70, Pl. II. $\bar{M}$: *e*=140° 4′. Also the annexed figure, M : a =124° 10′, M : a′=143° 37′, M : a″=153° 50′, M : *e*=135° 35′. *Cleavage* nearly equally perfect parallel to $\bar{M}$ and $\breve{M}$, less so parallel to P. *Imperfect crystallizations*, structure fibrous, lamellar, or granular,

and sometimes impalpable. The lamellar and columnar varieties are often curved or contorted.

H.=2·75—3·5. G.=2·899—2·957. *Lustre* somewhat pearly, parallel to $\bar{M}$ and $\breve{M}$; vitreous parallel to P; and in the imperfectly crystallized varieties, vitreous inclining to pearly. *Streak* grayish-white. *Color* white, sometimes with a grayish, bluish, or reddish tinge; also brick-red. *Fracture* uneven; of finely lamellar and fibrous varieties, splintery.

Composition, Lime 41·53, sulphuric acid 58·47.

It whitens under the blowpipe, but does not exfoliate like gypsum, and finally is covered with a friable enamel. With borax, it dissolves with effervescence to a transparent glass, becoming yellow, or brownish-yellow, on cooling.

Anhydrite sometimes attracts moisture, and assumes an appearance somewhat resembling gypsum. It is, however, readily distinguished by its cleavage.

OBS. Anhydrite has been variously denominated muriacite, anhydrite, tripe stone, (gekrösstein,) according to its structure; the first, when crystallized in broad lamellæ; the second, when granular; and the third when composed of contorted particles. Pseudomorphs in cubes, imitative of rock salt, have been described by Haidinger.

Fine specimens of the crystalline variety occur at the salt mines of Bex in Switzerland, and at Hall in the Tyrol. At Aussee, both the crystalline and massive varieties occur; the latter of a brick-red color. It is also found at Sultz, on the Neckar; at Bleiberg in Carinthia; at Ischl in Upper Austria; and at Berchtesgaden in Bavaria: the variety *gekrösstein* has been found principally at Wieliczka in Poland. The *Vulpinite*, from Vulpino, Italy, is harder than the other varieties, and admits of being cut and polished for ornamental purposes.

In the United States, it has been found at Lockport, N. Y., of a fine blue color, in geodes of black limestone, accompanied with crystals of calcareous spar and gypsum. The decomposed variety has also been observed at the same place, forming a thin incrustation on the foliated variety, and also between the folia.

HYDROBORACITE. BOROCALCITES FOLIATUS.

Hydrous Borate of Lime and Magnesia. Hydrous Calcareo biborate of Magnesia, *Thomson*.

Resembles fibrous and foliated gypsum.

H.=2. G.=1·9. Color white, with spots of red from iron. Thin plates translucent.

Composition, according to M. Hess, (Pogg. xxxi, 49,)

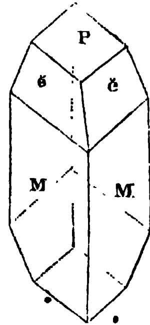
Boracic acid,	49·922	49·22
Magnesia,	10·430	10·71
Lime,	13·298	13·74
Water,	26·330=99·98	26·33=100

Fuses before the blowpipe to a clear glass, tinging the flame slightly green.

OBS. Hydroboracite was first observed by Hess, in a collection of Caucasian minerals. The specimen was full of holes, filled with clay, containing different salts. It may be mistaken for gypsum, but is readily distinguished by its fusibility.

BORATE OF LIME. Borocal[illegible]obliquus.

A. A. Hayes—(communicated to the author.)



ary form, an obtuse oblique rhombic prism; M : M=97° 30′ and 82° 30′—82° 36′, (Teschemacher.) *Secondary form*, the annexed figure; M : ĕ=147° 30′, (Teschemacher.) Also in masses having a globular form, consisting of interwoven fibres.

Crystals colorless and transparent. Fibrous masses opaque, snow-white, silky, and have a peculiar odor.

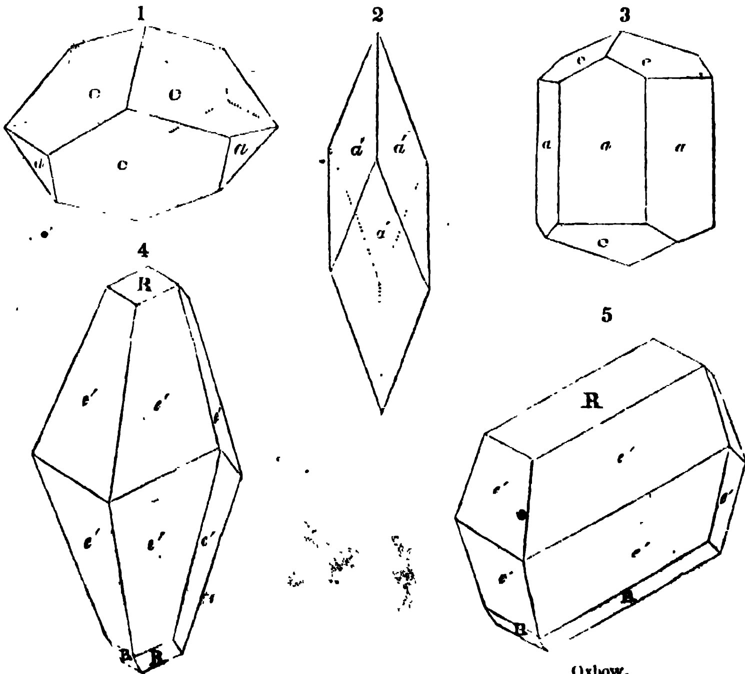
Composition, according to Hayes, a *Hydrous borate of lime*; the exact constitution has not yet been determined. In warm water the fibrous masses expand and form a consistent paste with more than eight times their volume. Mr. Hayes states that this variety contains more water than the crystals.

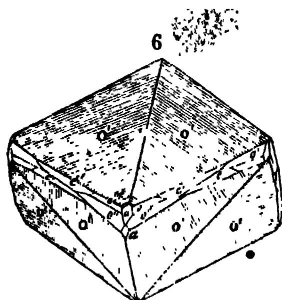
Obs. This salt occurs quite abundantly on the dry plains near Iquique, S. A., associated with magnesian alum, (Pickeringite of Hayes,) where it was obtained by Mr. J. H. Blake. The crystals are sometimes a quarter of an inch long.

CALCAREOUS SPAR. Calcialus rhombohedrus.

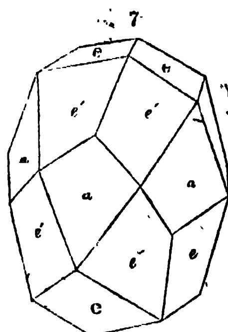
Rhombohedral Lime Haloide, *M.* Carbonate of Lime. Marl, Agaric Mineral, Anthraconite, Aphrite, Argentine, Chalk, Inolite, Marble, Oolite, Ostreocolla, Peastone, Pisolite, Slate Spar, Travertine, Tufa. Calcite. Natrocalcite.

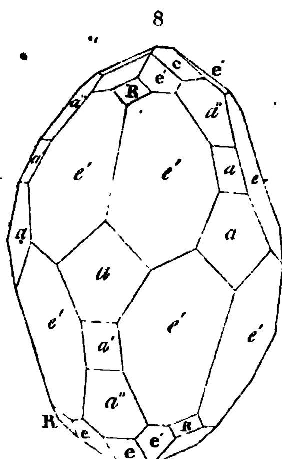
Primary form, an obtuse rhombohedron; R : R=105° 5′. *Secondary forms*, figures from 109 to 122, Pl. II; also the annexed figures.



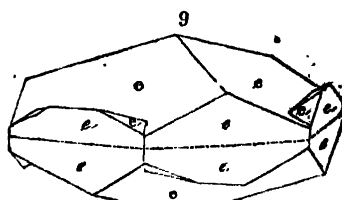


St. Lawrence Co., N. Y.

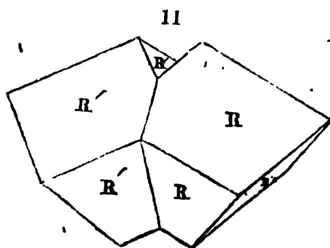


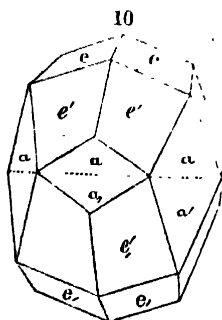


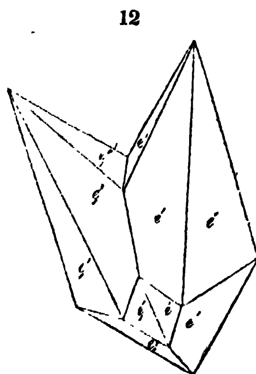
Derbyshire.

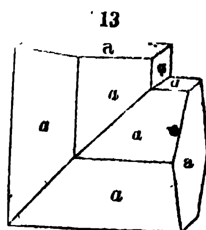


Alstonmoor.









R : *e'*=150° 58′ 16″. *e'* : *e'* (over a basal edge)=132° 58′. R : *a* =134° 36′. R : e=142° 32′. e : e=134° 57′. e : *a*=116° 15′. Several rhombohedrons of different angles, occur in nature. That

which is commenced by the planes a', in fig. 121, Pl. II, and when completed, resembles fig. 122, has its interfacial angles =78° 5′. Another, still more acute, is occasionally observed, the inclination of whose faces equals 65° 50′, (fig. 2;) and another of 60° 36′. Fig. 5 is a distorted scalene dodecahedron, from Rossie, St. Lawrence Co., N. Y. The lettering of its planes will explain its relation to the primary rhombohedron, and the scalene dodecahedron represented in fig. 4. *Cleavage* highly perfect, parallel to the primary faces R. *Compound crystals*, fig. 16, Pl. III. Fig. 9 is an instance of similar composition. The faces e are formed by a truncation of the terminal edges, (fig. 119, Pl. II.) The peculiar appearance of this compound crystal arises from the extension of each form beyond the face of composition. Figure 10 is an example of the same kind of composition in a different secondary: the uncompounded form is represented in figure 7. In figure 11 the composition is of the same kind, but has taken place parallel to a plane on a *lateral angle*. Figure 12 is another example of this mode of composition, occurring in a scalene dodecahedron, (fig. 116, Pl. II.) *Imperfect crystallizations*, structure fibrous, both coarse and fine; also lamellar and granular, coarse or impalpable; also stalactitic.

H.=2·5—3·5. G.=2·508—2·778. The purest kinds vary, according to Beudant, from 2·5239—2·7234, (Ann. des Mines, 2d Ser. V, 275.) *Lustre* vitreous—subvitreous—earthy. *Streak* white, or grayish-white. *Color* usually white; also various pale shades of gray, red, green, and yellow; also brown and black, when impure. Transparent—opaque. The transparent varieties exhibit *double refraction*. *Fracture* usually conchoidal, but obtained with difficulty, when the specimen is crystallized.

Composition, Lime 56·29, and carbonic acid 43·71. The colored varieties often contain, in addition, small portions of iron, silica, magnesia, alumina, bitumen, &c. Acids produce a brisk effervescence.

Before the blowpipe, it is infusible; it loses, however, its carbonic acid, gives out an intense light, and ultimately is reduced to pure lime, or *quicklime*. Many granular limestones phosphoresce with a yellow light when pulverized and thrown on a heated shovel.

Obs. Calcareous spar appears under a very great variety of forms and aspects, and, consequently, was distributed by the earlier mineralogists into several distinct species. These now constitute varieties.

The term *Iceland spar* is applied to transparent calc spar; the finest specimens come from Iceland. *Satin spar* is a fibrous carbonate of lime, having a delicate satin lustre. *Oolite* is a compact limestone consisting of minute spherical grains or particles resembling the roe of a fish; it is so called from ὠον, *an egg*. The *Peastone*, or *Pisolite*, differs from oolite in the larger size of its particles. These particles are composed of concentric laminæ. *Chalk* is a massive opaque variety, usually white, and possessing a purely earthy aspect, and absence of lustre. It is usually much softer than the other varieties of this species. *Agaric Mineral*, or *Rock Milk*, is a loose friable variety, deposited from waters containing carbonate of lime in solution. It is formed about lakes, whose waters are impregnated with lime; also, in fissures in limestone, and in limestone caverns. *Marble* includes all the imperfectly crystalline and earthy varieties which admit of a high polish. The *Stinkstone, Swinestone*, or *Anthraconite*, which is found columnar, granular, and compact, of various shades, emits a fetid odor, when struck with the hammer. *Stalactites* are pendent masses of limestone, formed in limestone caverns by the percolation of water, holding lime

in solution, through their rocky roofs; the evaporation of the water causes the deposition of the lime, and thus, in time, columns are often formed extending from the roof to the floor of a cavern. The water which drops to the floor from the roof also evaporates and forms a layer of limestone over the floor, which is called *Stalagmite*. *Argentine* possesses a silvery white lustre, and contains a little silica. *Marl* is a mixture of clay and carbonate of lime. *Calcareous Tufa* occurs in beds formed by deposition from water, and has a very porous structure. The *Fontainebleau Limestone* is an aggregate of secondary rhombohedrons, containing, mechanically mingled, large portions of sand. The name *Natrocalcite* has been applied to pseudomorphous crystals, having the form of prisms pointed at each extremity, as they sometimes contain a small portion of carbonate of soda. These forms are supposed by Descloiseaux to be imitative of selenite.

This species, in some forms, is very generally diffused. England and France contain extensive strata of chalk. Italy, from her Carrara beds, and Greece, from the Pentelican quarries, have provided the world with statuary marble. The greater part of the middle and western sections of the United States are underlaid with strata of limestone, and white or granular limestone occurs in various portions of the Eastern States.

The most interesting localities of calc spar in the United States, both as regards size of crystals and crystalline form, exist in St. Lawrence and Jefferson counties, New York. The finest specimens have been obtained at the Rossie lead mine. The crystals are highly modified and often transparent even when large. One gigantic crystal, nearly transparent, in the cabinet of B. Silliman, jr., weighs 165 pounds. At the Natural dam, two miles from Gouverneur, in the same vicinity, good crystals are obtained; also at the Wilson vein in Gouverneur, and the Jepson vein in Rossie. At the Paris ore bed in Gouverneur fine geodes occur in specular iron. In Jefferson county, near Oxbow, on the land of Mr. Benton, large crystals, sometimes as clear within as Iceland spar, have been obtained from a decomposing limestone. The rose and purple varieties are very beautiful. Some gigantic crystals weigh a hundred pounds and upwards. Four miles south of Oxbow, in Antwerp, there is a vein of calc spar and lead, which affords beautiful cleavage masses of white, purple, and brownish shades. Interesting crystallizations are also procured here. In Essex county, N. Y., town of Moriah, on Mill brook, near Port Henry, crystals of calc spar occur in white limestone. Dog tooth spar (fig. 4, and fig. 116, Pl. II) occurs of great beauty in Niagara county, near Lockport, with pearl spar, celestine, selenite, and anhydrite: also in Onondaga county, near Camillus, along the railroad. Good crystals are found in Herkimer county, a mile south of Little Falls, in the bed of a small stream; in Lewis county, at Leyden and Lowville, and at the Martinsburgh lead mine; and on the western bank of Dry Sugar River, near Boonville, Oneida county. In *Maine*, at Thomaston, lenticular and prismatic crystals are common. In *New Jersey*, at Bergen, fine crystallizations of yellow calc spar occur with Datholite, &c., in trap; at Franklin, a pink variety is met with, and good cleavage specimens may be obtained. In Nova Scotia, Partridge island affords a wine-colored calc spar, and other interesting varieties. *Argentine* occurs near Williamsburg and Southampton, Mass., and at the iron mines of Franconia, N. H. *Agaric mineral* covers the sides of a cave at Watertown, N. Y. *Stalactites* of great beauty occur in the celebrated Wier's cave, Virginia, and the large caves of Kentucky. Fine specimens are also found in the many caverns of Schoharie, N. Y., of which Ball's cave is the most famous. *Fibrous* carbonate of lime occurs in New York in considerable abundance at Camillus, and Schoharie, (near the Barytes locality,) and of a fine satin lustre near De Long's mill, St. Lawrence county.

The material of our common marbles is either granular or compact limestone. The white granular variety is used for building and sculpture. These rocks when burnt form quicklime. A fine compact limestone is employed in lithography. Calc spar is also used as a flux for smelting ores.

ARRAGONITE. CALCIALUS RHOMBICUS.

Prismatic Lime-Haloide, *M.* Eisenbluth, *W.* Igloite. Flos-ferri. Needle Spar.

Primary form, a right rhombic prism; M : M=116° 10′. *Secondary form*, M : ĕ=121° 55′, ĕ : a=125° 50′, ĕ : a′=109° 49′, ĕ : a″ =145° 19′. *Cleavage* parallel with M. *Compound crystals*, similar to the figures 13, Pl. III, and 3, 5, 6, and 11, Pl. IV; also

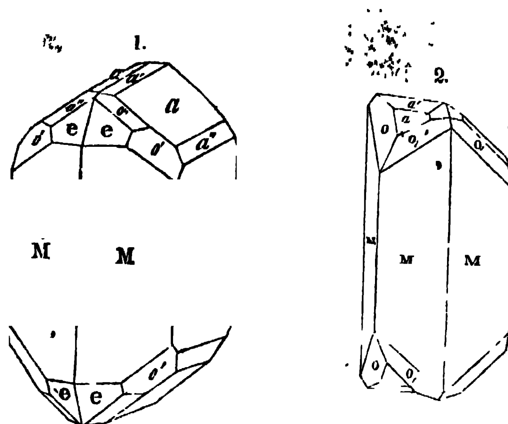


figure 2. *Imperfect crystallizations*, globular, reniform, and coralloidal shapes; columnar masses, composed of straight or divergent fibres.

H.=3·5—4. G.=2·931; Haidinger; 2·927, Biot. *Lustre* vitreous, sometimes inclining to resinous on surfaces of fracture. *Streak* grayish-white. *Color* white; also gray, yellow, green, and violet. Transparent—translucent. *Fracture* subconchoidal. Brittle. It possesses double refraction, but in a less degree than calcareous spar.

Composition, according to Stromeyer,

Carbonate of lime,	95·2965	99·2922
Carbonate of strontian,	0·5090	4·1043
Water,	0·1544=95·9599	0·5992 -103·9957

The carbonate of strontian is a very variable ingredient, and does not exist in all the varieties. Carbonate of lime is one of the dimorphous substances, calc spar being one of its forms, and the rhombic crystals of Arragonite the other.

When Arragonite is heated, it parts with its water of crystallization and falls to powder. It is phosphorescent on red hot iron, and soluble with effervescence in nitric and muriatic acids.

Obs. The most common repositories of Arragonite are beds of gypsum, beds of iron ore, (where it occurs in coralloidal forms, and is denominated *flos-ferri*, '*flower of iron*,') basalt, and trap rocks; occasionally, it occurs in lavas. It is often associated with copper and iron pyrites, galena, and malachite.

This mineral was first discovered at Arragon, in Spain, (whence its name,) in six-sided prisms, with gypsum, imbedded in a ferruginous clay.. It has since been obtained in compound hexagonal prisms at Bilin, in Bohemia, in a vein traversing basalt. The *flos-ferri* variety is found in the greatest perfection in the Styrian mines of Eisenerz, coating cavities and even caves of considerable extent, and associated with spathic iron. At Dufton, a silky fibrous variety called *Satin Spar*, occurs traversing shale in thin veins, generally associated with pyrites. In Buckinghamshire, Devonshire, &c., it occurs in stalactitic forms in caverns.

Flos-ferri occurs sparingly at Lockport, N. Y., coating gypsum in geodes; at Edenville, N. Y., lining cavities of mispickel and cube ore; at the Parish ore bed, Rossie; and at Haddam, Conn., in thin seams between layers of gneiss. A coralloidal Arragonite occurs in Chester Co., Pennsylvania.

DOLOMITE. CALCIALUS DOLOMII.

Macrotypous Lime Haloide, *M.* Bitter Spar. Pearl Spar. Magnesian Limestone. G Spar Bitterkalk. Bitterspath.

Primary form, an obtuse rhombohedron; R : R=106° 15′. *Secondary forms*, two acute rhombohedrons, (fig. 108, Pl. II;) in one a' : a'=79° 36′, from Gotha, in Saxony; in the other, a'' : a''= 66° 7′, from Hall, Tyrol. *Cleavage* perfect parallel to R. Faces a' usually with horizontal striæ. *Compound crystals*, similar to fig. 11, p. 244, presented by a greenish-white cleavable variety from Mexico. *Imperfect crystallizations*, imitative shapes; also amorphous, of a granular structure, coarse or fine, and grains often slightly coherent.

H.=3·5–4. G.=2·884, (from Miemo.) *Lustre* vitreous, inclining to pearly in some varieties. *Color* white, reddish, or greenish-white; also rose-red, green, brown, gray, and black. *Subtransparent* to translucent. Brittle.

Rammelsberg distinguishes four compounds of carbonate of lime and carbonate of magnesia; one, consisting of these carbonates in the proportion by weight of 54·18 to 45·82 (1 : 1,) which includes the common Dolomite and bitter spar; another, 63·95 to 36·05 (3 : 2,) including a Dolomite from Liebenstein and a bitter spar from Kolozoruk; a third, 70·28 to 29·72 (2 . 1,) including the *Gurhofite*, and crystallized bitter spar from Hall in the Tyrol, and from Taberg in Wärmland; and a fourth, 28·27 to 71·73 (1 : 3,) including the *Conite*.

Soluble in the acids, but more slowly than calcareous spar. Before the blowpipe, some varieties darken and increase in hardness.

Obs. The name *Dolomite* is applied to white crystals, and to the granular varieties. *Pearl* spar includes rhombohedral crystallizations with curved faces and a pearly lustre. When the crystals are not curved, and have a brown or reddish-brown color, they are called *brown spar*: this variety contains 5 to 10 per cent. of oxyd of iron or oxyd of manganese. *Gurhofite* is a compact snow-white subtranslucent variety, so named from a locality of it at Gurhof in Lower Austria.

Granular dolomite constitutes extensive beds in primitive regions. Crystalline and compact varieties are often associated with serpentine and other magnesian rocks.

Pearl spar occurs in geodes in compact limestones and other stratified rocks.

Dolomite occurs at Traversella in Piedmont, and at St. Gothard in the Appenines. Rhomb spar is found in Salzburg, the Tyrol, Miemo in Tuscany, from which the name *Miemite* was derived. Brown spar and pearl spar are obtained at Schemnitz in Hungary, Kapnik in Transylvania, at Freiburg in Saxony, in the lead mines of Alston in Derbyshire, and at other places in Devonshire.

Roxbury, Vt., affords large yellow transparent crystals of the rhomb spar variety, imbedded in talc. A coarse cleavable variety, occasionally presenting perfect crystals, is associated with white talc in calc spar, at Smithfield, R. I. The pearl spar variety is abundant in geodes at Lockport, Niagara Falls, and Rochester, N. Y., accompanying calc spar, celestine, and gypsum; also at Glen's Falls. Massive Dolomite forms extensive beds in Litchfield Co., Conn., in the southwestern towns of Massachusetts, in Vermont, in various parts of New York, Pennsylvania, New Jersey, Maryland, &c. Crystallized Dolomite occurs in rhombohedrons at the quarantine, Richmond Co., N. Y., and at Hoboken, N. J.

Gurhofite is found on Hustis's farm, Phillipstown, N. Y. It has a semi-opaline appearance, and a fracture resembling porcelain, and consists, according to Beck, (Min. Rep. N. Y., p. 254,) of carbonate of lime 66.75, carbonate of magnesia 26·50, silica 6·75.

Good brown spar occurs at Warwick, N. Y., and at the Parish ore bed, St. Lawrence county.

Dolomite is generally supposed to be injurious as a manure for soils, on account of its magnesia; but this is not so, unless used after calcination, before it is fully air-slaked. The lime it affords when burnt, makes a more durable cement than common limestone. The

rock is generally less firm or more friable than pure limestone, and therefore not as good for building stone This species was named of Dolomieu

ANKERITE. Calciaius decolorans

Paratomous Lime Haloide, *M* Rohe Wand and Wandstein of the Styrian miners

Primary form, an obtuse rhombohedron; R · R=106° 12′. *Cleavage* parallel with R. Occurs commonly in easily cleavable masses; also of a compact granular composition, in which the grains are distinctly discernible.

H.=3·5—4. G.=2·95—3·1. *Lustre* vitreous. *Streak* white. *Color* white, sometimes yellowish or brownish from an admixture of iron. Translucent—subtranslucent *Fracture* uneven.

Composition, according to Berthier, (T des Essais par la voie sèche i, 494,) Carbonate of lime 51·1, carbonate of magnesia 25 7, carbonate of iron 20 0, and carbonate of manganese 3 0=99 8

Before the blowpipe it blackens, and then will act upon the magnetic needle, but is infusible A pearly globule is formed with borax Exposure to the air darkens its surface

OBS This species occurs at Rathhausberg and Salzburg, also at the Styrian mines of Eisenerz, where it is valued both as an iron ore and a flux

The transition limestone about Quebec contains it in veins, and at West Springfield, Mass, it occurs in connection with the coal formation A brown spar from Johnsburg, Warren Co, N Y, and from the Parish bed, Jefferson Co, are referred by Beck, with some hesitation, to this species

It was first distinguished as a distinct species by Mohs, who named it after Prof Anker, of the Johanneum, in Gratz

MAGNESITE Magnesiaius rhombohedrus

Carbonate of magnesia Baudisserite Razoumoffskin Giobertite, *Beudant*

Primary form, an obtuse rhombohedron, R : R=107° 22′. *Cleavage* rhombohedral, perfect. Also massive; granular, or fibrous, and sometimes in radiating groups.

H.=3—4. G.=2 8—3. *Lustre* vitreous, fibrous varieties sometimes silky. *Color* white, yellowish or grayish-white, brown. Transparent—opaque. *Fracture* flat conchoidal.

Composition, according to Klaproth, (Beit v, 100,) and Stromeyer, (Untersuch, p 133)

	Steyermark	*Giobertite* Baumgarten
Magnesia,	48 00	47 6334
Carbonic acid,	49 00	50 7512
Water,	3 00	1 4037
Ox Mang	——=100, K	0 2117=100, S

It dissolves slowly, with little effervescence, in nitric or dilute sulphuric acid, and is infusible before the blowpipe

OBS Magnesite occurs associated with serpentine and other magnesian rocks This species occurs at Hrubschitz in Moravia, at the Gulsen mountains in Styria, at Baumgarten in Silesia, at Baudissero in Piedmont, and at Valecas in Spain

At Hoboken, N J, it occupies seams and cavities in Dolomite and serpentine, having a closely aggregated fibrous structure; also at Bolton, Mass, where it appears in delicate, indistinctly fibrous masses, traversing white limestone; at Lynnfield, Mass, coating serpentine

Carbonate of magnesia combines with carbonate of iron in various proportions. One of these compounds is described as mesitine spar, (Breithaupt,) and in the system is arranged near spathic iron. *Rhomb Spar* is another compound, containing 10 to 15 per cent. of carbonate of iron, (Brooke.) It resembles magnesite, except that it becomes brown on exposure. The angle is given at 107° 14′, which is the same with mesitine spar. The rhombohedral crystals in the steatite quarries of Marlboro', Vermont, Middlefield, Mass., and elsewhere, are referred by Shepard to this variety.

HYDROMAGNÉSITE. MAGNESIALUS PULVEREUS.

Hydro-carbonate of Magnesia, *Thomson*.

In crusts; also as a white powder. H.=2. *Lustre* earthy. *Streak* and *Color* white.

Composition, according to Wachtmeister, (K. V. Ac. H. 1827, p. 17,) and Kobell, (J. f. Pr. Ch. iv, 80,)

Magnesia,	42·41	43·96
Carbonic acid,	36·82	36·00
Water,	18·53	19·68
Silica,	0·57	0·36
Peroxyd of iron and foreign matter,	1·66=99·99, W.	——=100, K.

OBS. It accompanies magnesite, in India; occurs also in seams and in crusts, with magnesite, at Hoboken, N. J., and at other places in Richmond and Westchester counties, N. Y.

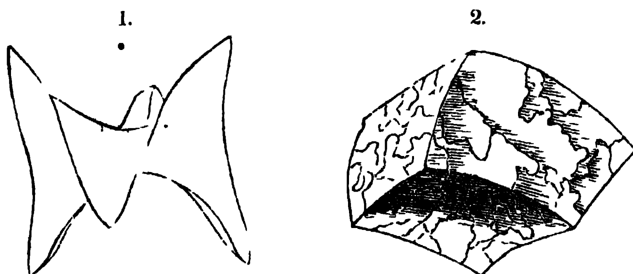
ORDER II. BARYTINEA.

SPATHIC IRON. MARANTALUS RHOMBOHEDRUS.

Brachytypous Parachrose Baryte, *M.* Rhombohedral Sparry Iron, *J.* Carbonate of Iron. Sparry Iron. Spathic Iron, *Phil.* Brown Spar. Stahlstein. Sphærosiderite. Clay Iron Stone. Siderose, *Beud.* Eisenspath and Spatheisenstein *of the Germans.* Junkerite, *Dufrenoy.*]

Primary form, an obtuse rhombohedron; R : R=107°. *Secondary forms*, similar to figs. 112, 113, Plate II; also 113, with the planes e of 119; e : e=136° 34′.

The faces often curved, as in the annexed figures. Figure 1 is an instance of several curvatures arising in part from the compound



nature of the crystal. *Cleavage* rhomboidal, perfect. *Imperfect crystallizations*, botryoidal and globular forms; occasionally in silky fibrous masses; also coarse or fine granular, to impalpable.

H.=3—4·5. G.=3·7317—3·829. *Lustre* vitreous—pearly. *Streak* white. *Color* ash-gray, yellowish-gray, greenish-gray, also brown, and brownish-red; sometimes white. Translucent—subtranslucent. *Fracture* uneven. Brittle.

Composition, according to Klaproth, (Beit. iv, 110,) Thomson, (Min. i, 445,) and Bischoff, (Ann. des Mines, 2d ser. i, 279,)

	Dankerode.	Slitt lead mine, Durham	*Sphærosiderite.*
Protox. Iron,	57·50	54·570	52·128
Carbonic acid,	36·00	35·900	32·231
Protox Mang.	3·30	1·155	——
Lime,	1·25	3·176	} 9·965
Magnesia,	——	——	}
Alumina,	——	——	5·676
Moisture,	——=98·05, K.	2·630= 97·431, T.	——=100, B.

In the blowpipe flame it blackens, giving off carbonic acid, and ultimately an oxyd of iron is obtained, which is attractable by the magnet. Alone, it is infusible. It colors borax green. It dissolves with difficulty in nitric acid, and scarcely effervesces, unless previ-

ously pulverized. Exposure to the atmosphere darkens its color, rendering it often of a blackish-brown, or brownish-red color.

OBS. Sparry iron occurs in many of the rock strata, in gneiss, mica-slate, gray-wacke, and in connection with coal formations. It is often associated with metallic ores. At Freiberg it occurs in silver veins. At Cornwall it accompanies tin. It is also found accompanying copper and iron pyrites, galena, vitreous copper, &c. In New York, according to Beck, it is almost always associated with specular iron. Occasionally it is to be met with in trap rocks.

In the region in and about Styria and Carinthia, this ore forms coherent tracts in gneiss, which extend along the chain of the Alps on one side into Austria, and on the other into Saltzburg. At Harzgerode in the Hartz, it occurs in fine crystals in gray-wacke; also in Cornwall, Alston Moor, and Devonshire.

The *Sphærosiderite* variety has a spheroidal form and radiated structure; it occurs at Hanau, where it occupies cavities in greenstone. Clay iron stone, which is a mixture of carbonate of iron and clay, occurs in the coal beds in the neighborhood of Glasgow; also at Mouillar, Magescote, &c., in France.

At Roxbury, Conn., a vein of considerable size occurs in a vein of quartz, which traverses a stratum of gneiss for upwards of half a mile. It is also obtained in considerable quantities at Plymouth, Vt., and at Sterling, Mass. In small quantities it occurs at Monroe, Con., in Lane's mine; also in rhombohedral crystals in New-York, at the Sterling ore bed in Antwerp, Jefferson Co., and at the Dodge ore bed in the town of Hermon, St. Lawrence county.

This ore is employed very extensively for the manufacture of iron and steel. On the Styrian bed, at the celebrated Erzberg, between Eisenerz and Vordenberg, 1200 men are constantly employed. The beds which occur in the coal formation in England, supply all the ore requisite for the immense quantity of iron annually smelted in Great Britain.

The *Junkerite* of Dufrenoy, described as a carbonate of iron occurring in rhombic prisms, has lately been shown by Breithaupt (Pogg. lviii, 278, 1843) to be nothing but common spathic iron, and consequently carbonate of iron is not dimorphous, as has been supposed.

MESITINE SPAR.

Mesitinspath. Rhombohedral Parachrose Baryte, *M.*

Primary form, an obtuse rhombohedron; R : R=107° 14′, Breithaupt. *Cleavage* rhombohedral, perfect.

H.=4. G.=3·35—3·63. *Lustre* vitreous. *Color* yellowish. Translucent.

Composition, according to Stromeyer,

Carbonic acid 44·23, protoxyd of iron 35·13, magnesia 20·64, with some protoxyd of manganese.

Acts before the blowpipe like spathic iron.

OBS. Occurs at Traversella in Piedmont.

OLIGON SPAR.

Oligonspath.

Primary form, an obtuse rhombohedron; R : R=107° 3′, Breithaupt. *Cleavage* rhombohedral, perfect.

H.=4. G.=3·745. *Lustre* vitreous. *Color* yellow, reddish-brown.

Composition, according to Magnus,

Carbonate of iron 59·99, carbonate of manganese 40·66.

OBS. Occurs at Ehrenfriedersdorf.

DIALLOGITE. MARANIALUS DECREPITANS.

Macrotypous Parachrose Baryte, *M.* Carbonate of Manganese. Rhodochrosite, and when mixed with Silicate of Manganese) Allagite, Photizite, Rhodonite. Manganspath.

Primary form, an obtuse rhombohedron; R : R=106° 51′. *Secondary form*, similar to fig. 119, Pl. II. *Cleavage* parallel to R. *Imperfect crystallizations*, globular and botryoidal forms, having a columnar structure, sometimes indistinct. Also granular varieties, occasionally of an impalpable structure.

H.=3·5. G.=3·592, var. from Kapnik. *Lustre* vitreous, inclining to pearly. *Streak* white. *Color* various shades of rose-red; brownish. Translucent—subtranslucent. *Fracture* uneven. Brittle.

Composition, according to Du Menil and Berthier,

				From Nagyag	
Oxyd of manganese,	51·60			56·00	
Carbonic acid,	33·75			38·60	
Protoxyd of iron,	1·87			——	
Silica,	4·37			——	
Lime,	2·50	97·09	Du Menil	5·40	100, Berthier

Before the blowpipe the color changes to gray, brown and black, and there is a strong decrepitation, but it is infusible *per se*. With glass of borax it fuses readily to a violet blue bead. Effervesces strongly with nitric acid. On exposure to the air its color is changed to brown, and some bright rose red varieties become paler.

Obs. Diallogite occurs commonly in veins along with ores of silver, lead, and copper; it is said to have been found also in transition mountains with other ores of manganese.

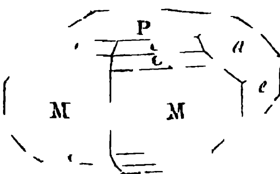
It is not uncommon in the Saxon mines; it occurs also at Nagyag and Kapnik in Transylvania, near Ellingerode in the Hartz, &c.

It has been observed in a pulverulent form coating Triplite at Washington, Conn., on the land of Joel Camp.

Breithaupt has separated from this species the ore from Kapnik, which contains, according to Berthier (in chemical mixture in part?) [illegible] per cent of silica, 30·4 of carbonic acid, 44 of protoxyd of manganese, and 4·3 of lime. Its hardness he states at 4·5—5. G.=3·592.

STRONTIANITE. BARALUS REBULLIENS.

Peritomous Hal Baryte, *M.* Carbonate of Strontian. Strontiane Carbonatée, *H.*



Primary form, a right rhombic prism, M : M 117° 19′. *Secondary form*, M : e 121° 20′, e′ : e′ 108° 12′, e : e′ 141° 20′. Crystals usually compound, resembling those of Arragonite. Surface P usually striated parallel to the shorter diagonal. *Cleavage* lateral, nearly perfect; traces parallel to e. *Imperfect crystallizations*, columnar globular forms; fibrous and granular.

H.=3·5—4. G.=3·605—3·713. *Lustre* vitreous; inclining to resinous on uneven faces of fracture. *Streak* white. *Color* asparagus green, apple green, also white, gray, yellow, and yellowish-brown. Transparent—translucent. *Fracture* uneven. Brittle.

Composition, Carbonic acid 29·93, and strontia 70·07.
Thomson found the two varieties from Strontian to contain,

	Green.	Brown.
Carbonate of strontia,	93·493	91·082
Carbonate of lime,	6·284=99·77	8·642=99·724

Another variety from the United States, which he has named *Emmonite*, in honor of Prof. Emmons, of Williams College, Mass., contains 12·5 per cent. of carbonate of lime. These are probably mechanical mixtures.

Effervesces with nitric and muriatic acids. Paper wet with the solution in these acids, and dried, burns with a red flame.

Before the blowpipe it fuses on the thinnest edges, turning the flame red. With a strong heat, the carbonic acid is expelled, and the assay then gives an alkaline reaction. With borax it effervesces strongly and yields a transparent globule.

OBS. Strontianite was first observed at Strontian in Argyleshire, in veins traversing gneiss, along with galena and heavy spar; it occurs there in stellated and fibrous groups, rarely in perfect crystals. Yorkshire and Braunsdorf in Saxony, are other localities.

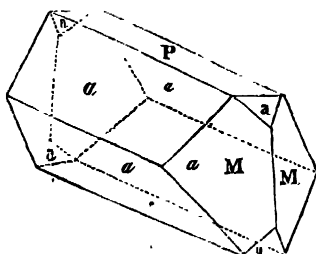
In the United States it occurs at Schoharie in granular and columnar masses, and also in finely terminated crystals, constituting nests or geodes often of large size in the hydraulic limestone. It is associated with heavy spar, iron pyrites, and calc spar. At Muscalonge Lake a massive and fibrous variety of a white or greenish white color is sometimes the matrix of the fluor spar of that region. Chaumont Bay in Jefferson Co., N. Y., is given as another locality. Massive Strontianite has been found by Mr. James Heron, at Warwick, N. Y.

CELESTINE. BARALUS PRISMATICUS.

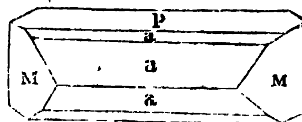
Prismatoidal Hal-Baryte, *M.* Sulphate of Strontian. Zölestine, *Wern.*

Primary form, a right rhombic prism; M : M=104°—104° 30′. *Secondary forms*,

1. Etna.



2. Lake Erie.



P : *a*=128° 1′, *a* : *a*=103° 58′, P : a=140° 42′, a : a=78° 35′, P : a′=157° 45′, a : a′=162° 57′. Fig. 1 is lengthened in the direction of its shorter lateral axis, and fig. 2 in the direction of the longer. *Cleavage* distinct parallel with M, less so parallel with P. *Imperfect crystallizations:* structure fibrous or columnar and radiated, also in globular masses of columnar composition; occasionally granular.

H.=3—3·5. G.=3·92—3·963. *Lustre* vitreous, sometimes inclining to pearly. *Streak* white. *Color* generally white, often bluish or reddish. Transparent—subtranslucent. *Fracture* imperfectly conchoidal—uneven. Very brittle.

Composition, when pure, Sulphuric acid 43·64, and strontia 56·36. Often mechanically mixed with carbonate of lime, sulphate of baryta, or oxyd of iron.

Before the blowpipe it becomes opaque and decrepitates; and on charcoal in the outer flame fuses rather easily to a milk-white alkaline globule. Phosphoresces when heated.

OBS. Celestine is usually associated with secondary, or transition limestone, or secondary sandstone. It also occurs in trap rocks and in beds of gypsum, in which it is often associated with sulphur.

Sicily has long been famous for the splendid groups of crystals of this mineral which there occur along with sulphur and gypsum. Fine specimens are met with at Bex in Switzerland, and Conil in Spain. Fibrous varieties of a blue color occur in clay, at Dornberg, near Jena. It is also found at Aust Ferry, near Bristol; in trap rocks near Tamtallan in East Lothian; near Knaresborough in Yorkshire, and at Norton in Hanover.

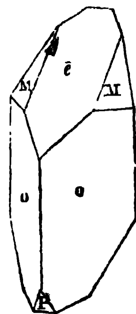
Beautiful specimens, finely crystallized, of a bluish tint, are found in great abundance in the secondary limestone about Lake Erie, and particularly on Strontian Island, where the rock abounds in splendid crystallizations of this species. Schoharie and Lockport, N.Y., also afford fine specimens. The Rossie lead mine has afforded beautiful crystallizations; also Chaumont Bay, Depeauville and Stark, (farm of James Coill,) New York. A blue fibrous celestine occurs at Franktown. Logan's Valley, Huntington Co., Pennsylvania. At the latter place it is associated with pearl spar and anhydrite.

Baryto-celestine. Dr. Thomson separates from the above species the radiated celestine, from Drummond's Island, Lake Erie, and Kingston, U. C. An analysis made in his laboratory, gave Sulphate of barytes 35·195, and sulphate of strontian 63·204, with a little iron and water. H.=2·75. G.=3·921. Color white, with a bluish tint; structure laminated, laminæ divergent.

BARYTO-CALCITE. BARALUS OBLIQUUS.

Brooke, Ann. Phil. viii, 114, 1824. Hemi-prismatic Hal-Baryte, *M.*

Primary form, an oblique rhombic prism; M : M =106° 54′. P : M=102° 54′. *Secondary form*, o : o=95° 15′. M : ē=143° 27′. *Cleavage* perfect parallel with M; less easily effected parallel with P. Occurs also massive.



H.=4. G.=3·6363—3·66. *Lustre* vitreous, inclining to resinous. *Streak* white. *Color* white, grayish, greenish, or yellowish. Transparent—translucent. *Fracture* uneven.

Composition, according to Children (Ann. Phil. viii, 115) and Richardson,

	Alstonmoor.	
Carbonate of baryta,	65·9	62·20
Carbonate of lime,	33·6	31·65
Sulphate of baryta,	——	0·30
Peroxyd of iron,	——	0·85
Water or volatile matter,	——=99·5, C.	3·45=98·45, R.

Before the blowpipe, alone, infusible. With borax, or salt of phosphorus, fuses to a transparent glass. Effervesces with muriatic acid.

OBS. It occurs at Alstonmoor in Cumberland, both massive and crystallized.

BROMLITE. BARALUS JOHNSTONII.

Johnston, Phil. Mag. vi, 1, and xi, 45. *Thomson*, ibid. x, 373, and Rec. of Gen. Sci. i, 373.

Primary form, a right rhombic prism. *Cleavage* indistinct. H.=2·5. G.=3·718, Thomson; 3·7, Johnston. *Lustre* vitreous. *Color* snow-white. Translucent. *Fracture* granular and uneven.

Composition, according to Thomson and Johnston,

Carbonate of baryta,	60·63	62·156
Carbonate of lime,	30·19	30·290
Carbonate of strontia,	——	6·641
Carbonate of manganese,	9·18=100, T.	——=99·087, J.

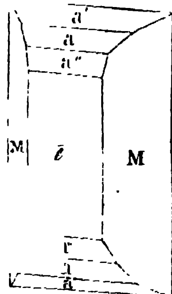
It is therefore identical in composition with baryto-calcite, although distinct in crystalline form.

Obs. This species was discovered by Johnston in the lead mine of Fallowfield, near Hexham, Northumberland. It has been since found at Bromley Hill, near Alston. It is said to occur at the latter locality in groups of crystals having the form of double six-sided pyramids, (figure 124, Plate II,) implanted upon a white crystalline substance resembling sulphate of baryta. This form is analogous to a secondary of Arragonite. (See figure 3, Plate IV.)

Breithaupt has lately described these crystals (Pogg. li, 516, 1840) as affording a rhombohedral cleavage, and consequently distinct in crystalline form from that described by Johnston: and he considers the carbonate of lime and baryta as not merely dimorphous but *trimorphous*. According to him R : R=104° 50′ to 105° 13′; and cleavage is distinct, but not perfect. Sp. gr.=2·819—2·83.

WITHERITE. BARALUS FUSILIS.

Withering, Phil. Trans. 1784, p. 293. Diprismatic Hal-Baryte, *M.* Carbonate of Barytes. Barolite.



Primary form, a right rhombic prism; M : M=118° 30′. *Secondary form*, M : ē=149° 15′. ē : a″=145° 30′, ē : a=126° 16′, ē : a′=110° 30′. *Cleavage* imperfect. *Compound crystals*, composition of the first kind, producing hexagonal prisms similar to those of Arragonite. *Imperfect crystallizations*, globular, tuberose, and botryoidal forms; structure either columnar or granular; also amorphous.

H.=3—3·75. G.=4·29—4·30. *Lustre* vitreous, inclining to resinous. *Streak* white. *Color* white, often yellowish, or grayish. Subtransparent—translucent. *Fracture* uneven. Brittle.

Composition, Baryta 77·59, carbonic acid 22·41.

It decrepitates under the blowpipe, and melts easily to a translucent globule, which becomes opaque on cooling. Dissolves with effervescence in dilute nitric or muriatic acid.

Obs. Witherite was first observed at Alstonmoor in Cumberland, associated with galena, in veins traversing the coal formation. The fibrous translucent variety occurs at Anglezark in Lancashire. Styria, Hungary, Siberia, and Sicily, are mentioned as other localities; but it is only abundant in England.

This mineral is poisonous, and is used in the north of England for killing rats.

DREELITE. BARALUS RHOMBOHEDRUS.

Dufrénoy, Ann. de Ch. et de Ph. lx, 102.

Primary form, an obtuse rhombohedron; R : R=93° or 94°. *Cleavage* apparent in traces only.

H.=3·5. G.=3·2—3·4. *Lustre* pearly; splendent on a surface of fracture. *Streak* and *Color* white.

Composition, according to Dufrénoy, Sulphate of baryta 61·[illegible], sulphate of lime 14·274, carbonate of lime 8·050, lime in excess 1·521, silica 9·712, alumina 2·404, water 2·308=100. Thomson has analyzed another compound of the sulphates of baryta and lime, consisting of 71·9 of the former to 28·1 of the latter.

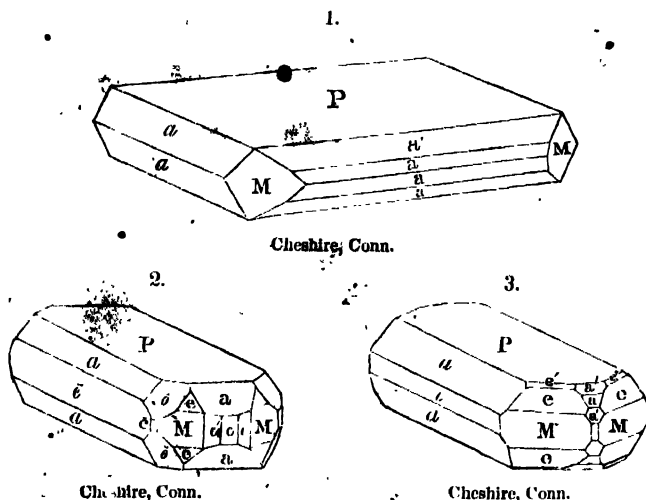
Obs. It occurs in small unmodified crystals, disseminated on the surface, and in the cavities of a quartzose rock.

It was named by Dufrénoy in compliment to M. de Drée, a liberal patron of science.

HEAVY SPAR. Baralus Ponderosus.

Prismatic Hal-Baryte, *M.* Sulphate of Barytes. Hepatite, *Haus.* Barytine, *B.* Baroselenite. Aerhenstein. Bolognian Spar. Cawk. Lithcospore. Stangenspath, *W.*

Primary form, a right rhombic prism; M : M=101° 40′. *Secondary forms :*



1. Cheshire, Conn. 2. Cheshire, Conn. 3. Cheshire, Conn.

M : ē=140° 50′, M : ē=129° 10′, P : a=141° 10′, P : a′=158° 04′, P : a″=121° 50′, P : e′=165° 26′, P : e=115° 41′, P : *a*=127° 18′, *a* : ē=142° 42′, ē : ē′=148° 27′, ē : ē′=151° 30′. *Cleavage* basal and lateral, perfect. *Imperfect crystallizations*, globular forms, fibrous or lamellar; coarsely laminated, laminæ convergent and often curved; fibrous; granular; colors sometimes banded like stalagmite.

H.=2·5—3·5. G.=4·3—4·72; the latter was obtained by Thomson, with a pellucid crystal. *Lustre* vitreous, inclining to resinous; sometimes pearly. *Streak* white. *Color* white; also inclining to yellow, gray, blue, red, or brown. Transparent to translucent—opaque. Some varieties are fetid, when rubbed.

Composition, Sulphuric acid 34, and baryta 66. Oxyd of iron, silica, carbonate of lime, and alumina, occur sometimes as impurities. Before the blowpipe it decrepitates, and is difficultly fusible. Some specimens lose their color when heated.

Obs. Heavy spar occurs commonly in connection with beds or veins of metallic ores. It is also met with in secondary limestones, sometimes forming distinct veins, and often in crystals, along with crystallizations of lime and strontian.

The most noted English locality is at Dufton, where large transparent crystals occur. In Mr. Allan's cabinet there is one crystal from this locality of a tabular form, which weighs forty-two pounds, and whose face P measures ten inches across.

Some of the most important European localities are at Felsobanya and Kremnitz in Hungary, and Roya and Roure in Auvergne. At Freiberg in Saxony, a variety occurs composed of indistinct prismatic crystals and having a pearly lustre; this is the *Stangenspath* of Werner. Rounded masses, composed of diverging columnar particles, occur at Mount Paterno, near Bologna, and have hence been called the *Bolognese stone*. At Staffordshire and Derbyshire is found an opaque massive variety of an earthy appearance and dirty-white color; this variety has been called *cawk*. The term *hepatite* has been applied to specimens which, by friction, emit a fetid odor.

In Cheshire, Conn., large distinct crystals, three or four inches long, and nearly transparent, are occasionally met with in red sandstone, along with vitreous copper and green malachite. Smaller crystals of perfect transparency are common, and large foliated massive specimens are abundant. Other similar localities are at Berlin, Farmington, and Southington, of the same State. A variety, indistinctly and very delicately fibrous, occurs in large masses, at Pillar Point, opposite Sackett's Harbor, N. Y. It here constitutes a solid vein, from two to three feet thick, in compact limestone. Large slabs are sometimes obtained and polished; and owing to the banded arrangement of the colors, they are often quite beautiful; the common colors are reddish-white, and grayish or yellowish-white. The earthy and foliated varieties are found at the Perkiomen lead mine, in Pennsylvania. At Schoharie, N. Y., a fibrous variety occurs with carbonate of lime, and the two are often mechanically mingled. In St. Lawrence Co., N. Y., fine tabular crystals occur in De Kalb, at Fowler with specular iron, the Parish ore bed with calc spar and specular iron, and on the bank of Laidlaw lake in Rossie; and the crested barytes is found at Hammond, with crystals of iron pyrites. At Wolcott, Wayne Co., near the stratum of lenticular iron ore, near Syracuse, and on the south side of the Mohawk, opposite Little Falls, are other localities of some interest. Hatfield and Leverett in Massachusetts, afford good specimens of heavy spar; also Piermont, N. H., Brown's creek and Haysboro', near Nashville, Tennessee, and the various lead mines of the West. Crystals of heavy spar, and also a friable granular variety, occur abundantly at Eldridge's gold mine, in Buckingham Co., Virginia, and three miles S. W. from Lexington, in Rockbridge Co.; a beautiful white variety is found on the plantation of J. Hord, Esq., Fauquier Co., Virginia.

The pure white varieties of heavy spar are ground up and employed as a white paint, either *per se* or mixed with white lead. This manufacture is carried on quite extensively at New Haven, Conn., and the paint is coming into very general use.

SULPHATO-CARBONATE OF BARYTA. *Thomson.*

The specimen, from which Dr. Thomson has derived the following description, consisted of a congeries of large six-sided prisms, terminated by low six-sided pyramids. H.=3. G.=4·141. *Lustre* vitreous. *Color* snow-white. Translucent. *Composition*, Sulphate of baryta 34·30, carbonate of baryta 64·82, carbonate of lime 0·28, moisture 0·60=100. Locality unknown.

FLUCERINE. SPANIALUS HEXAGONUS.

Fluate of Cerium.

Primary form, a hexagonal prism; occurs in six-sided prisms and plates; angles of the prism sometimes replaced; also amorphous. *Cleavage:* basal the most distinct.

H.=4—5. G.=4·7. *Lustre* weak. *Streak* white or slightly yellowish. *Color* dark-tile-red or almost yellow; deeper when the mineral is wet. Sub-translucent—opaque.

Composition, according to Berzelius, (Afhandlingar, v, 56,)

Peroxyd of cerium,	82·64
Yttria,	1·12
Fluoric acid,	16·24=100

Infusible, alone, before the blowpipe. In borax and salt of phosphorus, it fuses slowly but completely. The globule is blood-red in the exterior flame, but becomes colorless on cooling. In the interior flame it is colorless at all temperatures. In carbonate of soda it does not fuse, but swells out and is decomposed.

OBS. This mineral is of very rare occurrence, having been observed only at Finbo and Broddbo, near Fahlun, in Sweden, where it occurs imbedded in quartz and albite, accompanying pyrophysalite and orthite.

BASIC FLUCERINE. SPANIALUS DODECAHEDRUS.

Subsesquifluate of Cerium.

Usually massive; traces, sometimes, of the rhombic dodecahedron.

H.=5. *Lustre* vitreous. *Streak* fine yellow. *Color* a beautiful yellow, with some red; and when impure, brownish-yellow. Subtranslucent—opaque.

Composition, according to Berzelius, (Afhand. v, 64,) and Hisinger, (K. V. Ac. H. 1838, p. 189,)

Peroxyd of cerium,	84·20	Oxyd of cerium, (and lanthanum,)	36·430
Fluoric acid,	10·85	Fluorid of cerium, (and lanthanum,)	50·150
Water,	4·95	Water,	13·413
	100·00, B.		99·993, H.

Infusible in the blowpipe flame, but blackens. On cooling, passes through dark-brown and red tints, and nearly resumes its original color, being a little redder than at first. With borax, salt of phosphorus, and carbonate of soda, it acts like the last species. It dissolves in hot sulphuric acid, forming a yellow solution. With muriatic aid, chlorine is copiously evolved.

OBS. It accompanies the compact black Allanite in small quantities at Bastnäs in Sweden, and at Finbo, near Fahlun.

CARBONATE OF CERIUM. SPANIALUS QUADRATUS.

Berzelius, Brewster's Journ. iii, 334.

In thin four sided crystalline plates of a grayish-white color.

Composition, according to Hisinger, Oxyd of cerium 75·7, carbonic acid 10·8, and water 13·5. Exposed to a low red heat, it loses 19 per cent. of its weight, without changing its appearance. With the fluxes, gives the reaction of pure oxyd of cerium.

OBS. It is found coating the cerite of Bastnäs in Sweden, and is probably produced by the decomposition of that mineral.

YTTRO-CERITE. SPANIALUS RHOMBICUS.

Pyramidal Cerium-Baryte, *M.* Yttrocererite, *v. Leonh.*

Massive. *Cleavage* apparent parallel to a rhombic prism of 108° 30′.

H.=4—5. G.=3·447, Berz. *Lustre* glistening; vitreous—pearly. *Color* violet-blue, inclining to gray and white, often white; sometimes reddish-brown. Opaque. *Fracture* uneven.

Composition, according to Berzelius, (Afhandlingar, iv, 151,) Fluoric acid 25·05, lime 47·63, oxyd of cerium 18·22, yttria 9·11. The yttro-cerite of Finbo whitens before the blowpipe, previous to its attaining a red heat, but is infusible *per se*. With the addition of gypsum, it fuses to a bead, which on cooling becomes of a white or grayish color. In a pulverized state, it dissolves completely in heated muriatic acid, forming a yellow solution. The yttro-cerite of Broddbo does not fuse with gypsum.

OBS. It occurs sparingly at Finbo and Broddbo, near Fahlun in Sweden imbedded in quartz, and associated with albite and topaz.

XENOTIME. SPATHUM PERITOMUM.

Pyramidal Retin-Baryte, M. Phosphate of Yttria. Phosphorsaure Yttererde. Ytterspath.

Primary form, a right square prism. *Secondary form*, similar to fig. 64, Pl. I. M : e=about 135°. *Cleavage* lateral, perfect. H.=4·25—5. G.=4·5577. *Lustre* resinous. *Streak* pale-brown. *Color* yellowish brown. Opaque. *Fracture* uneven and splintery.

Composition, according to Berzelius, (K. V. Ac. H. 1824, p. 334,)

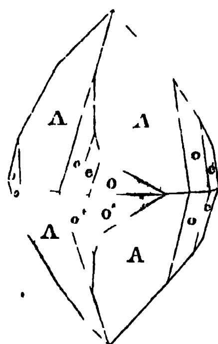
Yttria,	62·58	
Phosphoric acid,	33·49	
Subphosphate of iron,	3·93	100

Before the blowpipe it comports itself like apatite, but differs from that mineral by its infusibility *per se*. With borax it affords a colorless globule, which becomes milky on cooling. With biphosphate of soda it dissolves with great difficulty to a clear colorless glass; in this particular also it differs from apatite, as that mineral fuses easily with this reagent. Effervesces strongly with carbonate of soda, and produces a light gray infusible slag. Insoluble in acids.

OBS. This mineral was discovered at Lindesnaes in Norway, in a vein composed chiefly of coarse granite.

TUNGSTATE OF LIME. SCHEELIUS PYRAMIDALIS.

Pyramidal Scheelium Baryte, M. Tungsten. Scheelite, L.



Schlackenwald.

Primary form, a square octahedron; A . A (over a terminal edge)=100° 8′, A : A (over a basal edge)=130° 20′. *Secondary forms*, similar to figs. 55 and 57, Pl. I; also the annexed figure; A : e=140° 4′. *Cleavage* parallel to A perfect, though interrupted by a conchoidal fracture; traces parallel to e. *Compound crystals*, composition parallel to planes truncating the basal edges. *Imperfect crystallizations:* reniform shapes with columnar structure; also granularly massive.

H.=4—4·5. G.=6·076, of a white crystalline variety from Schlackenwald, as determined by Haidinger. *Lustre* vitreous, inclining to adamantine. *Streak* white. *Color* white, inclining to yellow and brown; sometimes almost orange-yellow. Subtransparent—translucent. *Fracture* uneven. Brittle.

Composition, according to Berzelius, Lime 19·40, and tungstic acid 80·417. Bucholz and Brandes (Schw. J. ix, 285) obtained

Tungstic acid,	78·00	76·50
Lime,	19·06	[illegible]
Oxyd of iron,	——	1·47
Silica,	2·08	2·94
Alumina,	——=100·14, Buch.	1·09=98·60, Br.

Infusible alone before the blowpipe, except that the thinnest edges are partially vitrified. With borax it yields a white glass, the transparency of which depends on the quantity of salt employed. When thrown into nitric acid, it becomes yellow, but does not dissolve.

Obs. Tungstate of lime is usually associated with primary rocks, and is commonly found in connection with tin ore, topaz, fluor, apatite, molybdena, or wolfram, in quartz. It occurs at Schlackenwald and Zinnwald in Bohemia, in large crystals at Caldbeck-fell near Keswick with apatite, molybdena and wolfram; Schellgaden in Salzberg, Harzgerode in Anhalt, and Cornwall, are other localities of this mineral.

In the United States it is found both crystallized, in the forms above referred to, and massive, at Monroe and Huntington, Conn., at Lane's mine, where it is associated with wolfram, pyrites, rutile and native bismuth in quartz.

Tungstate of lime has not been employed in the arts. If found in abundance, it would yield a yellow paint, (tungstic acid,) superior in beauty to chrome yellow. Small quantities have been manufactured and sold by the proprietor of the Monroe mine.

TUNGSTIC ACID. SCHEELIUS OCHREUS.

Silliman, American Journal of Science, iv. 2.

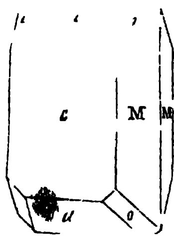
Pulverulent. *Color* bright yellow. *Lustre* earthy.

Composition, Oxygen 20.226, tungsten 79.774. It is pure tungstic acid.

Obs. This species occurs at Lane's mine, Monroe, Conn., filling small cavities in other ores of tungsten, or coating them, and has resulted from their decomposition; also with the foreign ores of tungsten.

WHITE ANTIMONY. STIBIATES RHOMBICUS.

Prismatic Antimony Baryte, *M.* Oxyd of Antimony. Antimony Bloom. Weiss Spiess Glanzerz, *W.*, *Hof.* Spiesglanzweiss, *Haus.* Antimonblüthe, Antimonoxyd. Antimoine Oxidé, *H.*



Braunsdorf

Primary form, a right rhombic prism, M : M = 136° 58'. *Secondary form*, rectangular plates, with the lateral edges replaced by planes which are inclined at an angle of 136° 31'; acicular rhombic prisms; also the annexed figure; M : e = 111° 31', a : e = 144° 44', a : a (adjacent planes) = 70° 32'. *Cleavage:* lateral, highly perfect, and easily obtained. *Compound crystals:* composition of the second kind, parallel with e; the union of thin plates by this kind of composition produces the common forms of this species, which were formerly supposed to be simple forms, and the planes of separation to be cleavage joints. *Imperfect crystallizations:* structure lamellar, columnar, and granular.

H. = 2.5—3. G. = 5.566, crystals from Braunsdorf. *Lustre* adamantine, often pearly; shining. *Streak* white. *Color* snow-white, occasionally peach-blossom-red, and ash-gray. Translucent—subtransparent. Sectile.

Composition, according to Vauquelin, (Haüy's Min. iv. 274,) oxyd of antimony 86, ditto and oxyd of iron 3, silica 8=97. When pure it consists of antimony 84.32, and oxygen 15.68. Melts in the flame of a candle, and before the blowpipe is entirely volatilized, covering the charcoal with a white coating.

Obs. The tabular crystallizations of this species occur in small quantities at Przibram in Bohemia, in veins traversing primitive rocks; and the prismatic have been observed at Braunsdorf, near Freiberg in Saxony, Malaczka in Hungary, Allemont in Dauphiny, and

elsewhere in Europe. It is usually associated with other ores of antimony, and also those of lead, together with blende and calcareous spar.

Antimonic and Antimonous acids. Two acids of antimony, the antimonic and antimonous, have been observed in nature in pulverulent forms of yellowish white and grayish colors. One contains oxygen 19·87, antimony 80·13; the other oxygen 23·66, antimony

ROMEINE. STIBIALIS QUADRATUS.

Ann. des Mines, xx, Third series, 247.

Primary form, a square octahedron; basal angle according to Dufrenoy 110° 50′—110° 20′; angle of the pyramid 68° 10′—69°. Occurs in groups of minute crystals.

Scratches glass. *Color* hyacinth or honey yellow.

Composition, according to Damour (Ann. des Mines,)

Antimonous acid,	79·17
Protoxyd of iron,	1·19
Protoxyd of manganese,	2·16
Lime	16·65
Silica	0·64
	99·81

Obs. Romeine was found at St. Marcel in Piedmont, in small nests or veins in the gangue which accompanies manganese, consisting in part of feldspar, epidote, quartz, brown iron ore, and Greenovite. It is named in honor of Romé de l'Isle.

ANTIMONOPHYLLITE.

Breithaupt, Jahresbericht for 1832, p. 202.

Crystallized in thin unequiangular six-sided prisms, of a grayish white color. It contains oxyd of antimony. Locality unknown.

BISMUTITE. BISMUTATUS ACICULARIS.

Bismutit, *Breithaupt*, Pogg. liii, 627. Carbonate of Bismuth.

In implanted acicular crystallizations, and massive.

H.=4—4·5,—3·5 specimens that have lost their lustre. G.=6·86—6·909. *Lustre* vitreous when pure—sometimes dull. *Streak* greenish gray to colorless. *Color* mountain-green and dirty siskin-green, occasionally straw yellow and yellowish-gray. Subtranslucent—opaque. Brittle.

Melts on a charcoal, and is reduced with effervescence to a metallic globule, covering the coal at the same time with white oxyd of bismuth. Dissolves in nitric acid, affording a deep yellow solution. According to Plattner's examinations, it is a carbonate of bismuth, containing some iron and copper, (perhaps a carbonate of each,) and also sulphuric acid.

Obs. Bismutite occurs in Cornwall, at Schneeberg with native bismuth, and near Hirschberg in Russian Voigtland, with brown iron ore, native bismuth, and bismuth glance.

BISMUTH OCHRE. Bismutalus ochraceus.

Oxyd of Bismuth. Wismuthocker, W. Bismuth Oxydé, H.

Crystalline form not observed. Occurs massive and disseminated, pulverulent, earthy, also passing into foliated.

G.=4.3611, Brisson. *Lustre* adamantine—dull, earthy. *Color* greenish yellow, straw-yellow, grayish-white. *Fracture* conchoidal—earthy.

Composition, according to Lampadius, (Handb. z. Chem. Anal. p. 286.) Oxyd of bismuth 86.4, oxyd of iron 5.1, carbonic acid 4.1, water 3.4=99. Before the blowpipe on charcoal, it is easily reduced to the metallic state, and subsequently the greater part may be dissipated.

Obs. It occurs pulverulent at Schneeberg in Saxony, at Joachimsthal in Bohemia, and with native gold and an ore of bismuth at Beresof in Siberia.

BISMUTH BLENDE. Bismutalus dodecahedrus.

Arsenical Bismuth. *Breit.* Pogg. 1827, p. 175. Kieselwismuth. Silicate of Bismuth, *Thom.*

Primary form, according to Breithaupt, the rhombic dodecahedron, fig. 7, Pl. I. *Secondary forms*, figs. 30, 34, and 35, Pl. I. *Cleavage* parallel to the faces of the dodecahedron. It usually occurs in minute crystals, but also presents globular forms, composed of columnar, lamellar, or granular particles.

H.=3.5–4.5. G.=5.912—6.006. *Lustre* resinous or adamantine. *Streak* yellowish-gray. *Color* dark hair brown, yellowish-gray, and straw yellow. Subtransparent—opaque. *Fracture* uneven. Rather brittle.

Composition, according to Kersten, (Pogg. xxvii, 81,)

Oxyd of bismuth,	69.38
Silica,	22.23
Phosphoric acid,	3.31
Peroxyd of iron,	2.40
Sesquioxyd of manganese,	0.30
Fluoric acid and water,	1.01=98.6

Heated in a glass tube it decrepitates and affords a trace of water. It fuses before the blowpipe to a dark yellow mass and gives out fumes destitute of smell. It fuses and froths on charcoal, staining it yellowish brown, sometimes with a tinge of green. Fuses readily with soda to a button, at first greenish-yellow, and then reddish yellow. On charcoal, with borax, it is ultimately reduced to the metallic state. With salt of phosphorus, it fuses to a yellow globule, with a silica skeleton, which becomes colorless on cooling.

Obs. This mineral is found in the neighborhood of Schneeberg in Saxony in quartz.

CALAMINE. Zincalus rhombohedrus.

Rhombohedral Zinc-Baryte, *M.* Zinkspath, *L.* Carbonate of Zinc. Galmey (in part.)

Primary form, an obtuse rhombohedron, R : R=107° 40′. *Secondary form*, $a : a'$=113° 31′, and 66° 29′. Primary planes



Retzbanya.

generally curved and rough. *Cleavage* rhombohedral perfect. *Imperfect crystallizations* reniform, botryoidal or stalactitic shapes, also granular, and sometimes impalpable. Occasionally earthy and friable. Also in crystalline incrustations and pseudomorphs imitative of crystals of calcareous spar.

H.=5. G.=4·334, Smithson; 4·442, Haidinger, a honey yellow crystallized variety from Aix la Chapelle. *Lustre* vitreous inclining to pearly. *Streak* white. *Color* white, often grayish, greenish, brownish white, sometimes green and brown. Subtransparent—translucent. *Fracture* uneven—imperfectly conchoidal. Brittle.

Composition according to Smithson (Nicholson's Jour., vi, [illegible]):

	Somersetshire.	Derbyshire.
Carbonic acid,	35·2	34·8
Oxyd of zinc,	64·8—100	65·2—100

Loses its transparency in the blowpipe flame but does not melt; the carbonic acid is driven off and oxyd of zinc is obtained or passes off in white flakes. Dissolves with effervescence in nitric acid. It becomes negatively electrified by friction.

Obs. Calamine is found both in veins and beds, especially in company with galena and blende; also with copper and iron. It usually occurs in calcareous rocks, and is generally associated with electric calamine.

Fine specimens of calamine are obtained in Siberia; one variety has a dark brown color, and contains cadmium; another is of a beautiful bright green. Other localities are Dognatzka and the Bannat of Temeswar in Hungary, Bleiberg and Raibel in Carinthia, Altenberg, near Aix la Chapelle. Concentric botryoidal groups are met with in the Mendip hills and at Wanlockhead in Dumfriesshire.

In the United States calamine is found in great abundance in Jefferson county, Missouri, at a lead mine called Valle's diggings; Hamburg, near the Franklin furnace, New Jersey; the Perkiomen lead mine, Pennsylvania; and the lead mine at Brookfield, Conn., afford it in small quantities. At the Perkiomen mine it occurs only in a pulverulent form and results from the decomposition of red zinc ore.

ZINC BLOOM. ZINCATUS OCHRACEUS.

Smithsonite. Dicarbonate of Zinc. Zinkblüthe.

Earthy incrustations. H.=2—2·5. G.=3·58—3·6. *Lustre* dull. *Color* white, grayish, or yellowish. Opaque.

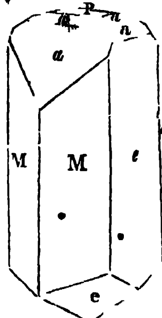
Composition according to Smithson, Carbonic acid 13·52, oxyd of zinc 69·36, water 15·10=97·98.

Before the blowpipe it gives off abundant white fumes, which are deposited on the charcoal.

Obs. It occurs with ores of zinc and lead at Bleiberg.

ELECTRIC CALAMINE. ZINCALUS PERITOMUS.

Prismatic Zinc Baryte, *M.* Siliceous Oxyd of Zinc, Silicate of Zinc, *Thom.* Galmey (in part.) Zinkglas, *Haus.* Zinc Oxidé Silicifere, *H.*



Aix la Chapelle

Primary form, a right rhombic prism; M : M = 103° 53′ and 76° 7′. *Secondary form*, M : M = 76° 7′, M : l = 141° 56′, P : a′ = 154° 14′, P : a = 124° 37′, P : a′ = 148° 20′, P : a = 118° 23′. *Cleavage* perfect parallel to M, traces parallel to P. *Imperfect crystallizations* stalactitic, mammillated, botryoidal, and fibrous forms; also massive and granular.

H = 4·5—5, the latter when crystallized. G = 3·434, Smithson;—3·379, Haidinger. *Lustre* vitreous, subpearly on P, sometimes adamantine. *Streak* white. *Color* white; sometimes blue, green, yellow, or brown. Transparent—translucent. *Fracture* uneven. Brittle. Assumes electric polarity by friction or heat.

Composition according to Smithson, (Nicholson's Jour., vi, 78,) and Berzelius, (K. V. Ac. H. 1819, p. 141,)

			Altenberg
Silica,	25·0	24·893	26·23
Oxyd of Zinc,	68·3	66·837	66·37
Water	4·4	7·460	7·40
Carbonic acid,	——	0·450	——
Oxyds of lead and tin,	——=97·7, S.	0·276=99·916, B.	——=100, B.

When pulverized, it dissolves in heated sulphuric or muriatic acid, and the solution gelatinizes on cooling. In the blowpipe flame, it decrepitates, loses its transparency, intumesces, and emits a green phosphorescent light. It is infusible alone; but with borax melts to a clear glass, which becomes opaque on cooling.

OBS. Electric calamine and calamine are usually found associated in veins in calcareous rocks, accompanying ores of blende, iron, and lead. The localities of this species are the same as given for the preceding. Pseudomorphs, imitative of calcareous spar, are common in Derbyshire, and also at Schemnitz in Hungary.

In the United States, it occurs with calamine in Jefferson county, Missouri; also at the Perkiomen lead mine, and on the Susquehanna, opposite Selinsgrove, and abundantly at Austin's mines in Wythe county, Virginia.

WILLEMITE. ZINCALUS ACROTOMUS.

Anhydrous Silicate of Zinc, *Thom.* Williamsite. Wilhelmite. Hebetine.

Primary form, an obtuse rhombohedron; R : R = about 133°, Breit. *Secondary form*, similar to fig. 110, Pl. I. *Cleavage* indistinct at right angles with the vertical axis. Occurs also in reniform masses; also granular—impalpable.

H. = 5—5·5. G. = 4—4·1. *Lustre* resinous. *Streak* white or yellowish. *Color* yellow, yellowish-brown, reddish-brown. Translucent—opaque.

It is a silicate of zinc, containing a little oxyd of iron

Composition, according to Dr Thomson (Min i, 545,) and Vanuxem and Keating, Jour Ac Nat Sci Philad. iv, 3,)

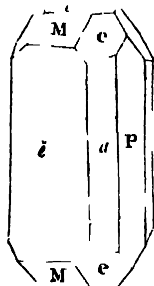
Oxyd of [illegible]	68 77	71·33
Silica,	26·97	25 00
Peroxyd [illegible]	1 48	0 67
Alumina,	0 66 ox mang.	2 66
Do with a trace of zinc and iron,	0 78	—
W[illegible],	1 25=99 91, T	—=99 66, V and K.

Decrepitates before the blowpipe, tinging the flame green, but does not fuse With nitric or muriatic acid, it forms a jelly

Obs Willemite is occasionally met with associated with calamine, upon the Old Mountain in Limburg It also occurs at Franklin, New Jersey

HOPEITE Zincalus diatomus

Prismatic Monoclas Haloide, *M* *Brewster*, Trans Royal Soc Edin x, 107 Zinkphyllit, *Br*



Primary form, a right rhombic prism; M : M=101° 24′. *Secondary form*, M : ĕ=140° 42′, M : e=129° 18′, ĕ : a=130° 47′, P : a=139° 13′. *Cleavage* parallel with ĕ highly perfect. Plane P striated. Occurs also in reniform masses, and amorphous.

H =2·5—3. G =2·76. *Lustre* vitreous; somewhat pearly upon ĕ. *Streak* white. *Color* grayish-white, reddish-brown when compact. Transparent—translucent. Possesses double refraction. Sectile.

Dissolves without effervescence in muriatic or nitric acid, and is slowly affected by sulphuric acid Before the blowpipe it gives out its water of crystallization, and then melts to a clear colorless globule, which tinges the flame green The globule obtained with borax remains clear on cooling With soda, it affords a scoria which is yellow when hot, and gives out copious fumes of zinc and some of cadmium. The fused mineral forms a fine blue glass, with a solution of cobalt. Hopeite is supposed, therefore, to be a compound of phosphoric acid and zinc, with a small portion of cadmium, and some water

Obs It has been observed only in the calamine mines of Altenberg, near Aix la Chapelle It was first distinguished as a species by Sir David Brewster, and named in honor of Prof Hope of Edinburgh

TRIPLITE Manganalus quadratus

Prismatic Retin Baryte, *M* [illegible] Phosphate of Manganese Pitchy Iron Ore

Imperfectly crystalline. *Cleavage* in three directions perpendicular to each other; one the most distinct.

H.=5—5·5. G.=3 439—3 775. *Lustre* resinous, inclining to adamantine. *Streak* yellowish-gray. *Color* blackish-brown. Subtranslucent—opaque. *Fracture* small conchoidal.

Composition, [illegible] Vauquelin, Oxyd of iron 31, oxyd of manganese 42, and phosphoric acid [illegible] according to Berzelius, phosphoric acid 32 8, protoxyd of iron 31 9, protoxyd of manganese 32 6, with 3 2 of phosphate of lime

Before the blowpipe it fuses easily to a black scoria Dissolves readily in nitric acid, without effervescence. With borax, gives a glass colored with manganese

Obs It occurs at Limoges in France, in a vein of quartz in granite, accompanied by apatite

In the U[illegible] States it is met with in considerable abundance, at Washington, Conn., where its si[illegible]n is similar to that at Limoges. It is associated with pulverulent diallogite. It is found in small quantities [illegible]ompanying spodumene, at Sterling, Mass.

HETEROZITE. M[illegible] OBLIQU[illegible]

Heterosit, *Alluau. Vauquelin*, Ann. de Chim. xxx, 294. [illegible]

Primary form, an oblique rhombic prism: occurs massive. *Cleavage* parallel with the faces of an oblique rhombic prism.

H. about 6. G. when fresh 3·52, after exposure 3·39. *Lustre* resinous, like that of apatite. *Color* greenish-gray or bluish; becomes violet after long exposure, and its lustre is changed to submetallic.

Composition, according to Dufrénoy, (Ann. de Ch., et de Ph., xli, 342,)

Phosphoric acid,	41·77
Oxyd of iron,	34·89
Red oxyd of manganese,	17·57
Silica,	0·22
Loss by heat,	4·40=98·85

It dissolves in acids, excepting its silica. Before the blowpipe it yields by fusion a brown enamel, of a submetallic lustre.

Obs. It is met with at Thoreaux in the Haute Vienne. It was first observed and named by Alluau, and described by Vauquelin.

PHOSPHATE OF IRON AND MANGANESE.

Ferner—J. für Pract. Chem. xviii, 490.—Berz. Jahresb. xx, 246.

Crystallization appears to be like that of apatite. Occurs in crystalline masses; cleavage distinct, but imperfect.

H.=5. G.=3·97. *Lustre* greasy. *Streak* grayish-white. *Color* clove-brown. *Fracture* uneven or imperfect conchoidal.

Composition, according to Ferner,

Phosphoric acid 35·60, protoxyd of iron 35·44, protoxyd of mangan[illegible] 20·34, fluorine 3·18, iron 4·76, silica 0·6.

Decrepitates before the blowpipe and finally melts to a bluish-black glass, attracted by the magnet.

Obs. This mineral was met with near Zwisel in B[illegible], imbedded in granite.

HURAULITE. MANGANALUS FUSILIS.

Vauquelin, Ann. de Chim. et de Ph. xxx, 302.

Primary form, an oblique rhombic prism; M : M=117° 30′, P : M=[illegible]. *Secondary form*, the primary with the lateral solid angles deeply replaced; *a* : *a*=88°, M : *a*=[illegible]. *Cleavage* none.

H. above 3. G.=2·27. *Lustre* vitreous. [illegible]dish-yellow, a little lighter than the color of hyacinth. Transparent.

Composition, according to Dufrénoy, (Ann. de Ch. xli, 3[illegible],) Phosphoric acid 38, protoxyd of iron 11·1, protoxyd of manganese 32·85, water 18=99·85. It is very fusible.

Before the blowpipe it melts to a black button, having a metallic lustre ... d in a glass tube, it affords some water Insoluble in acids

OBS It occurs in minute crystals, occupying small veins in granite, near Limoges in the Commune of Hureaux, whence its name It is associated with a fibrous phosphate of iron

Hureaulite re... ...con in color, but is readily distinguished by the irregular form of its crystals a... inferior hardness.

CUBE ORE Arsenatus cubicus

Hexahedral Lirocone Malachite, *M* Hexahedral Olivenite, *J*, Pharmakosiderit, *Haus*. Würfelerz, *W* Fer Arseniaté, *H* Siderite, *Br*

Primary form, the cube. *Secondary forms*, figs. 28, 33, also 28 and 5 combined, Pl I. *Cleavage* cubic, imperfect. P sometimes striated parallel to its edge of intersection with a; (fig. 28.) Faces on the angles often curved Rarely granular.

H.=2.5 G 3 *Lustre* adamantine, not very distinct. *Streak* olive green—brown, commonly pale. *Color* olive green, passing into yellowish-brown, bordering sometimes upon hyacinth-red and blackish-brown; also passing into grass-green and emerald-green. Subtranslucent Rather sectile.

Composition, according to Berzelius, (K V Ac H 1824, p. 354,)

Arsenic acid,	37 82
Peroxyd of iron,	39 20
Water,	18 61
Phosphoric acid,	2 53
Oxyd of copper,	0 65
Insoluble matter,	1 76=100 57

Exposed to a gentle heat, it becomes red; a higher temperature causes intumescence, but drives off little or no arsenic, and leaves a red powder Copious arsenical fumes are emitted when supported on charcoal before the blowpipe, and a metallic scoria is obtained in the reducing flame, which acts on the magnetic needle

OBS Cube ore is obtained at the mines of Huel Gorland, Huel Unity, and Carharrak in Cornwall, coating cavities in quartz, and associated with several o the ores of copper also at St Leonhard in France, and at Schneeberg and Schwarzenberg in Saxony

IRON SINTER. Arsenatus pictus

Diarsenate of Iron Eisensinter and Eisenpecherz of the Germans

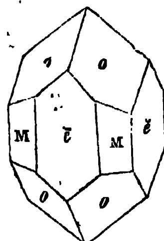
Reniform and massive. H.=2. G.=2·2—2·4. *Lustre* vitreous, sometimes greasy. *Color* yellowish and reddish-brown, blood red, and white. *Streak* yellow—white. Translucent—opaque.

Composition ... to Kersten, (Schweig Jahrb xxiii, 176,) Arsenic acid 30·25, peroxyd of iro... with a trace of sulphuric acid 28 80=99 20 Acts before the ...e like ...

... ...curs ...berg An ore on Hopkins' farm, near Edenville, N. Y., is referred by Beck ... this species.

SCORODITE. Arealus trimetricus.

Peritomous Fluor-Haloide, *Haid.* Skorodite. Martial Arseniate of Copper, *P.* Cupreous Arseniate of Iron, *Bournon.* Skorodit, *Breit.*



Primary form, a right rhombic prism; M : M=119° 2′. *Secondary form*, M : ē=149° 31′, o : o=115° 6′ and 102° 1′. *Cleavage* indistinct parallel with M and ē.

H.=3·5 –4. G.=3·162—3·3, Haidinger. *Lustre* vitreous—subadamantine. *Streak* white. *Color* pale leek-green, or liver-brown. Subtransparent—translucent. *Fracture* uneven.

Composition, according to Berzelius, (K. V. Ac. H. 1824, p. 350,) and Boussingault, (Ann. de Ch. xli, 75,)

	Brazil.	Popayan.
Arsenic acid,	50·78	49·6
Peroxyd of iron,	34·85	31·3
Oxyd of lead,		0·4
Arsenate of alumina,	0·67	——
Water,	15·55=101·85, Berz.	16·9=101·2, Bouss.

Gives out an alliaceous odor before the blowpipe, and fuses to a reddish-brown scoria, which acts upon the magnet when all the arsenic is expelled.

Obs. A brown-colored variety occurs in the primitive mountains of Schwarzenberg in Saxony, associated with arsenical pyrites, and at Löling, near Huttenberg in Carinthia, along with leucopyrite. A leek-green scorodite is found in the Cornish mines, coating cavities of ferruginous quartz. Minas Geraes, in Brazil and Popayan, have afforded some fine specimens.

It occurs in minute crystals and druses of leek-green, grass-green, and greenish-white colors, near Edenville, N.-Y., associated with arsenical pyrites, iron sinter, &c., in a vein in white limestone.

The name of this species is derived from σκοροδον, *garlic*, and was applied because of its odor before the blowpipe.

CHENOCOPROLITE.

Gansekothig-Erz *of the Germans.* Ganomatite, *Breit.*

Presents mammillary forms.

H.=2—3. *Lustre* resinous. *Streak* white. *Color* yellow, or pale-green. Translucent. *Fracture* conchoidal.

Before the blowpipe, it evolves copious arsenical fumes, and fuses to a blackish scoria; when the heat is continued on charcoal, it fuses and yields a button of silver, but the slag contains metallic iron, which strongly affects the magnet. Chenocoprolite appears, therefore, to be an arsenate of silver and iron.

Obs. The principal localities of this species are in the Hartz, at the mines of Clausthal. It is also found in Cornwall, and at Allemont in Dauphiny. When abundant, it is highly valued as an ore of silver.

Chenocoprolite is a translation of the German name, which was given it in allusion to its peculiar color and general appearance.

TRIPHYLINE. Arealus Rhombicus.

Primary form, a right rhombic prism; M : M=about 132°. *Cleavage* parallel with P perfect; parallel with M and one of the

diagonals imperfect, the latter the least so. Occurs commonly massive.

H.=5. G.=3·6. *Streak* grayish-white. *Color* greenish-gray; also bluish. Translucent in thin fragments.

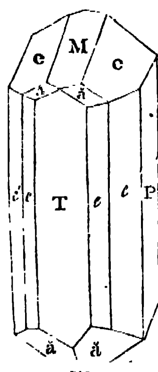
Composition, according to Fuchs, (Erd. und Schweig. J. für Chem. iii, 98,) Phosphoric acid 41·47, protoxyd of iron 48·57, protoxyd of manganese 4·7, lithium 3·4, silica 0·53, water 0·68=99·35. Fuses easily before the blowpipe, losing 0·68 per cent. of water at a red heat, and forms a dull steel-gray magnetic bead. It dissolves readily in borax, and affords a green glass. It is soluble in the acids.

Obs. Triphyline occurs at Bodenmais in Bayern. It was first described by Fuchs, and named from τρις, *three*, and φυλη, *family*, in allusion to its containing three phosphates.

A similar compound from Keiti in Finland, has been analyzed by Nordenskiöld, and named *Tetraphyline*. It differs in physical characters from the preceding, in presenting a yellow color on its surface of fresh fracture, which by degrees becomes black. The following analysis exhibits its peculiarities in composition: Phosphoric acid 42·6, protoxyd of iron 38·6, protoxyd of manganese 12·1, magnesia 1·7, lithia 8·2=103·2; the excess is supposed to be owing to an incorrect determination of the quantity of lithia.

VIVIANITE. Arealus rhomboideus.

Prismatic Iron-Mica, *M.* Dichromatic Euclase-Mica. *Haid* and *M.* Phosphate of Iron. Blue Iron Earth. Mullicite, *Thom.* Fer Phosphaté, *H.* Blaue Eisenerde, *Wern.* Eisenblau. Fer azuré, *H.* Glaukosiderit, Eisenphyllit, Siderischer Diatomphyllit, *Breit.*



Primary form, a right rhomboidal prism; M : T=125° 18′. *Secondary form*, P : e′=125° 56′, T : e=165° 25′, M : e=150° 30′, M : e=117° 40′, T : ă=125° 25′, Phillips. Surface P smooth, others striated. *Cleavage* highly perfect parallel with P; traces in other directions. *Imperfect crystallizations*, reniform and globular; also in light particles, forming coatings.

H.=1·5—2. G.=2·661. *Lustre* pearly or metallic-pearly on P. The other faces vitreous. *Streak* bluish-white, soon changing to indigo-blue. The color of the dry powder, liver-brown. *Color* various shades of blue and green; deepens by exposure. Usually green at right angles with the vertical axis, and blue parallel to it; the two colors mingled, produce the dirty-blue color which the mineral ordinarily presents. Transparent—translucent; opaque on exposure. *Fracture* not observable. Thin laminæ flexible. Sectile.

Composition, according to Vögel and Stromeyer, (Untersuchungen, p. 274,)

	Bodenmais.	Cornwall.
Protoxyd of iron,	41·0	42·38
Phosphoric acid,	26·4	28·69
Water,	31·0=98·4, V.	28·93=100, S.

Decrepitates in the blowpipe flame, loses its color, and becomes opaque; if pulverized, it fuses to a dark brownish black scoria, which affects the magnetic needle. Heated in a glass tube, it yields pure water. Dissolves in dilute nitric and sulphuric acids.

Obs. It occurs associated with magnetic and common iron pyrites in copper and tin veins; also in narrow veins with gold, traversing gray-wacke; occasionally, it is met with in trap rocks. The friable varieties occur in clay, and are sometimes associated with bog iron ore.

Near St. Agnes in Cornwall, transparent crystals of an indigo color have been found, an inch in diameter and two in length, on magnetic pyrites. Bodenmais, and the gold mines of Vöröspatak in Transylvania, afford crystalline specimens. On the promontory of Kertz in the Black Sea, it has been found in large indistinct crystals, occupying the interior of shells. The earthy variety, which is sometimes known under the name of *blue iron*, or *native Prussian blue*, (*fer azuré*,) occurs in Greenland, Stiria, Carinthia, Cornwall, &c. The friable varieties have been discovered in bog iron ore in several peat swamps in the Shetland Isles, and at Ballagh in the Isle of Man, accompanied with animal matter, particularly the horns of elk and deer, and near an old slaughter-house in Edinburgh.

Fine translucent crystals of Vivianite, presenting a dark-blue color, are met with at Imleytown, New Jersey. At Allentown, Monmouth Co., N. J., it occurs in considerable abundance, both crystallized in nodules and earthy, imbedded in bog iron ore, and associated with clays; also at Mullica Hill, Gloucester Co., N. J., (the mullicite of Thomson,) in cylindrical masses consisting of divergent fibres or acicular crystals. At Franklin, N. J., this species is occasionally found. It often fills the interior of belemnites and gryphites, in the ferruginous sand formation. At Harlem, N. Y., vivianite in crystals accompanies stilbite and feldspar in the fissures of gneiss. It occurs in the north part of Somerset and Worcester Cos., Maryland, with bog ore in Stafford Co., Virginia, and eight or ten miles from Falmouth, with gold and galena.

The *blue iron earth*, or earthy variety of this species, contains

	Klaproth, (Beit. iv, 120.)	Brandes, (Schweig. Jahrb. xxvi, 77.)
Phosphoric acid,	32·0	30·320
Protoxyd of iron,	47·5	43·775
Water,	20·0	25·000
Alumina,	——	0·700
Silica,	——=99·5	0·025 =99·820

Its color is at first grayish-white, but becomes blue on exposure to the air: it soils slightly, and has a somewhat harsh feel.

ANGLARITE. AREALUS DIVERGENS.

Berthier, Ann. des Mines, xii, 303. Diphosphate of Iron.

In fibrous masses and radiating needles.

Lustre vitreous. *Streak* lighter than the color. *Color* bluish-green, blue, bluish-black, brown. Translucent—opaque.

Composition, according to Vauquelin and Berthier,

Phosphoric acid,	24·8	28·82
Protoxyd of iron,	51·0	56·67
Water,	15·0	14·51
Protoxyd of manganese,	9·0=99·8, V.	——=100, B.

Fuses before the blowpipe to a black globule. In the matrass, it yields water.

OBS. This species occurs at Anglar, in the department, Haute Vienne.

GREEN IRON ORE. AREALUS VIRIDIS.

Fibrous and radiated. *Lustre* silky, weak. *Color* dull leek-green: alters on exposure to yellow and brown. Subtranslucent.

Composition, according to Karsten;

Phosphoric acid 27·717, peroxyd of iron 63·450, water 8·560=99·727, (Saxony.) Yields water when heated in a glass tube. Fuses easily to a black porous slag.

OBS. Occurs in Saxony.

Alluaudite. This is a dull green or brownish, reniform, fibrous mineral from Hureaux, France, consisting, according to Vauquelin, of Peroxyd of iron 56·90, tritoxyd of manganese 6·15, phosphoric acid 38·35, water 9·20=99·90. H.=3. G.=3·227.

The *Melanchor* of Fuchs (J. f. Pract. Ch. xvii, 171) is a phosphate of iron from Rabenstein, containing in 100 parts 38·9 peroxyd, and 3·87 protoxyd of iron. The name alludes to its black color.

CARPHOSIDERITE.

Karphosiderite, *Breithaupt.* Brewster's Journal, viii, 181.

In reniform masses.

H.=4—4·5. G.=2·5. *Lustre* resinous. *Streak* unchanged, glimmering. *Color* pale and deep straw-yellow. *Feel* greasy.

Contains Oxyd of iron, phosphoric acid, and water, with small quantities of manganese and zinc. It dissolves readily with borax, and fuses with salt of phosphorus to a black scoria.

Obs. This species was first distinguished by Breithaupt, among some Greenland specimens. It resembles oxalate of iron. Its name alludes to its straw-yellow color, and is derived from *καρφος, straw*, and *σιδηρος, iron.*

PYROSMALITE. Arealus hexagonus.

Pyrodmalit, *L.* Fer muriaté, *H.* Hexagonal Pyrosmalite-Mica, *Breit.*

Primary form, a rhombohedron. *Secondary form*, a hexagonal prism with basal edges replaced; also in hexagonal tables. *Cleavage* perfect, perpendicular to the vertical axis. Also massive.

H.=4—4·5. G.=3·81, Hisinger. *Lustre* of a, the terminal face of the hexagonal prism, pearly; of other planes, less so. *Streak* paler than the color. *Color* pale liver-brown, passing into gray and pistachio-green; usually brown externally, and light greenish-yellow internally. *Fracture* uneven, rather splintery. Somewhat brittle.

Composition, according to Hisinger, (Afhand. iv, 317.)

Silica,	35·850
Protoxyd of iron,	21·810
Protoxyd of manganese,	21·140
Basic muriate of iron,	14·095
Lime,	1·210
Water and loss,	5·895

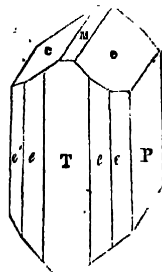
Becomes reddish-brown in the blowpipe flame, and emits copious fumes of muriatic acid. In a strong heat it fuses to a black slag, which at last becomes a round globule, attractable by the magnet. With borax it fuses readily, and presents the appearances characteristic of iron and manganese. It dissolves in muriatic acid, leaving a small residuum of silica.

Obs. Pyrosmalite has been found only at Bjelkegruvan, one of the iron mines of Nordmark, in Wermeland, Sweden, where it is associated with calc spar, pyroxene, apophyllite, and magnetic iron. A crystal from this locality, in the museum at Stockholm, is nearly an inch in diameter, and one and a quarter inches long, and weighs five and a half ounces; its form is a six-sided prism. The secondary form given above, is presented by a crystal in the cabinet of Mr. Heyer, of Dresden.

The name Pyrosmalite is derived from *πυρ, fire*, and *'οσμη, odor*, and alludes to the odor given off before the blowpipe.

COBALT BLOOM. Cobaltalus rubellus.

Hemiprismatic Euclase-Haloide, *Haid* and *M*. Prismatic Red Cobalt, *J*. Red Cobalt Ochre. Arseniate of Cobalt. Cobalt Mica. Diarseniate of Cobalt, *Thom*. Kobalt blüthe, *Haus*. Cobalt Arseniaté, *H*.



Primary form, a right rhomboidal prism; M : T=124° 51′. *Secondary form*, M : e=149° 12′, e : e=118° 23′, T : e=155° 5′, T : e′=137° 6′, e : e=130° 10′, e′ : e′=94° 12′. Surface P and T vertically striated. *Cleavage* parallel to P highly perfect, indistinct parallel to M and T. *Imperfect crystallizations*: globular and reniform shapes, having a drusy surface, and a columnar structure: sometimes stellate, and thus aggregated. Also pulverulent, incrusting other minerals.

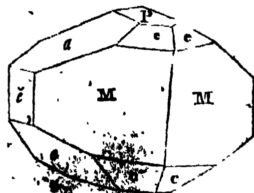
H.=1·5—2; the lowest degree upon P. G.=2·948. *Lustre* of P pearly, especially of the cleavage face; of other faces, adamantine, inclining to vitreous; also dull and earthy. *Streak* a little paler than the color. *Color* crimson and peach-red, sometimes pearl, or greenish-gray. The red tints incline to blue, if seen in a direction perpendicular to P. The dry powder has a deep lavender-blue tinge, which is not the case when the mineral is crushed in water. Transparent—subtranslucent. *Fracture* not observable. Thin laminæ flexible in one direction. Sectile.

Composition, according to Bucholz, (Gehlen's Journ. 2d ser. ix, 314,) Arsenic acid 37·9, oxyd of cobalt 39·2, water 22·9. Darkens *per se* in the blowpipe flame, and emits copious arsenical fumes; in the reducing flame, it fuses to a globule of arsenid of cobalt. With borax and other fluxes, it yields a fine blue glass.

Obs. It occurs at Schneeberg in Saxony, in micaceous scales, stellularly aggregated. Brilliant specimens, consisting of minute aggregated crystals, are met with at Saalfield in Thuringia; and at Riegelsdorf in Hessia. The earthy peach-blossom varieties have been observed in Dauphiny, in Cornwall, and at the lead mine of Tyne Bottom, near Alston, in Cumberland. A perfectly green variety occurs at Platten in Bohemia, and sometimes red and green tinges have been observed on the same crystal.

Cobalt bloom, when abundant, is valuable for the manufacture of smalt. This species resembles red antimony, and capillary red copper ore. From both of these minerals, however, the effects under the blowpipe readily distinguish it. Moreover, the color of the former is more sombre, of the latter, more brilliant than cobalt bloom.

ROSELITE. Cobaltalus rhombicus.



Primary form, a right rhombic prism; M : M=132° 48′. *Secondary form*, the annexed figure. *Cleavage* distinct and brilliant, parallel to ĕ. Twin crystals are of common occurrence.

H.=3. *Lustre* vitreous. *Streak* white. *Color* deep rose-red. Translucent.

According to an imperfect analysis by Children, it contains Oxyd of cobalt, lime, arsenic acid, magnesia, and water. Before the blowpipe it parts with its water of crystallization, and becomes black. With borax and salt of phosphorus, it yields a blue globule.

Obs. Its only known locality is at Schneeberg in Saxony, where it has been found in

small quantities on quartz. It resembles cobalt-bloom in color, and was at first mistaken for it. Its distinctive characters, particularly crystallographic, were observed by Levy, who named the mineral after the distinguished Dr. Gustavus Rose, of Berlin.

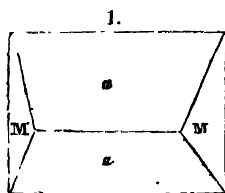
ARSENITE OF COBALT. COBALTALUS OCHRACEUS.

Earthy incrustation of a carmine-red or rose-red color. Consists of arsenous acid, cobalt, and water. Acts before the blowpipe like cobalt bloom.

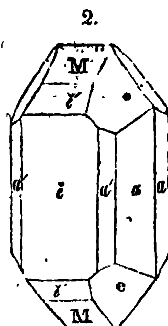
WHITE LEAD. CRONALUS RHOMBICUS.

Diprismatic Lead-Baryte, *M.* White Lead Ore. Carbonate of Lead. Ceruse, *Beud.* Blei Erde, *Wern.*

Primary form, a right rhombic prism; M : M=117° 13′, and 62° 47′. *Secondary forms:*



Johanngeorgenstadt.



Johanngeorgenstadt.

M : ĕ=121° 24′. M : ĕ′=150° 2′. *a* : *a*=140° 15′, and 39° 45′. ĕ : *a*′=145° 20′, ĕ : *a*=109° 53′. *Cleavage* parallel to M often perfect. *Compound crystals*, figures 5, 6, 8, Pl. IV. *Imperfect crystallizations*, rarely fibrous, often granularly massive and impalpable.

H.=3—3·5. G.=6·465—6·480. *Lustre* adamantine, inclining to vitreous or resinous; sometimes pearly. The former is sometimes metallic, if the colors are dark. *Streak* white. *Color* white, gray, grayish-black, sometimes tinged blue or green by some of the salts of copper. Transparent—subtranslucent. *Fracture* conchoidal. Very brittle.

Composition, according to Klaproth, (Beit. iii, 167,) and Thomson,

	Leadhills.	
Carbonic acid,	16·00	16·406
Protoxyd of lead,	82·00	83·534
Water,	2·00=100, K.	0·060=100, T.

Before the blowpipe it decrepitates, becomes yellow, then red, and finally, with care, a globule of lead may be obtained. It dissolves readily, and with effervescence in dilute nitric acid.

OBS. Leadhills and Wanlockhead are among the finest localities of this mineral. At these places it occurs with other ores of lead in transition slate. Beautiful crystals are met with at Johanngeorgenstadt; at Nertchinsk and Beresof in Siberia; near Bonn on the Rhine; at Clausthal in the Hartz; at Bleiberg in Carinthia; and at Mies and Przi-

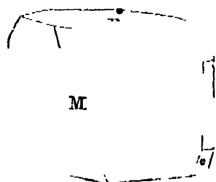
bram in Bohemia. In England, it has been observed at Alston Moor, Keswick, and particularly in Cornwall, where, in the mine of St. Minvers, it occurs in exceedingly delicate crystals. Opaque pseudomorphs, imitative of crystals of Anglesite, have been met with at Leadhills.

Fine crystals have been obtained at the Perkiomen lead mines, near Philadelphia. It also occurs at Valle's Diggings, Jefferson Co., Missouri, and in other mines of the West. Brigham's mines, near the Blue Mounds, affords it in considerable quantities. It occurs as an incrustation, at Southampton, Mass. The lead mines of St. Lawrence Co., N. Y., contain much of this ore, but it has not been observed there in a crystalline state. Splendid crystallized specimens are obtained at Austin's mines, Wythe Co., Virginia, and in Davidson's county, North Carolina.

CORNEOUS LEAD. CRONALUS QUADRATUS.

Orthotomous Lead-Baryte, *M.* Murio-Carbonate of Lead. Chloro-Carbonate of Lead, *Thomson.* Bleihornerz *of the Germans.*

Primary form, a right square prism. *Secondary forms*, similar to figs. 53 and 61, Pl. I; and also combinations of the two. M : e= 135°; also the annexed figure. M : e=146° 54′. P : e=123° 6′, Brooke. *Cleavage* bright parallel to M, and the diagonals.



H.=2·75—3. G.=6—6·1. *Lustre* adamantine. *Streak* white. *Color* white, gray, and yellow. Transparent—translucent. Rather sectile.

Composition, according to Klaproth, (Beit. iii, 141,)

Oxyd of lead 85·50, muriatic acid 8·5, and carbonic acid with some water 6·0=100, which is equivalent to lead 31·57, chlorine 10·93, oxyd of lead 51·50, and carbonic acid 6=100.

Before the blowpipe it melts readily to a yellow globule, which on cooling becomes white and crystalline. On charcoal, lead is obtained.

OBS. The localities of this rare mineral are Matlock in Derbyshire, and Hausbaden, near Badenweiller, in Germany; also Southampton, Mass., in the United States. At each of these localities, it accompanies other ores of lead.

COTUNNITE. CRONALUS VESUVIANUS.

Cotunnia, *Monticelli.* Cotunnite, *Von Kobell.* Chlorid of Lead, *Thomson.*

In acicular crystals.

May be scratched by the nail. *Lustre* adamantine; inclining to silky or pearly. *Streak* white. *Color* white.

Composition, according to Berzelius, Chlorine 25·48, and lead 74·52.

It fuses readily in the flame of the blowpipe and colors the flame blue, giving off white vapors, which condense on the charcoal. With carbonate of soda it yields a globule of lead. It dissolves in about twenty-seven times its weight of cold water.

OBS. This mineral was observed by Monticelli and Covelli, in the crater of Mount Vesuvius, after the eruption of 1822. It was accompanied with chlorid of sodium, and chlorid and sulphate of copper. It was named in honor of a distinguished medical man at Naples.

CERASITE. CRONALUS PERITOMUS.

Peritomous Lead-Baryte, *M.* Muriate of Lead. Dichlorid of Lead, Berz. ——— Mendiffite. Kerasite.

Primary form, a right rhombic prism; M : M=102° 27′. Occurs in fibrous or columnar masses, often radiated; admits of a highly perfect cleavage parallel to M.

H.=2·5—3. G.=7—7·1. *Lustre* pearly upon cleavage faces. *Streak* white. *Color* white, with a tinge of yellow or red. Feebly translucent—opaque.

Composition, according to Berzelius,

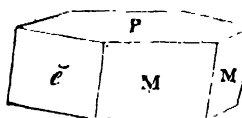
Lead,	83·2
Chlorine,	13·77
Carbonic acid,	1·03
Silica,	1·46
Water,	0·54=100

It decrepitates slightly under the heat of the blowpipe, and readily fuses, producing a globule of a deeper yellow color than the original specimen. On charcoal, lead may be obtained. Treated with peroxyd of copper and salt of phosphorus, the flame assumes an intensely blue color.

Obs. This rare mineral occurs at the Mendip Hills, in Somersetshire, on earthy black manganese. Its name is derived from κερας, *horn*.

LEADHILLITE. Cronalus acrotomus.

Axotomous Lead-Baryte, *M.* Sulphato-Tricarbonate of Lead, *Brooke*, Ed. Phil. Jour. iii, 117. Rhomboidal Carbonate of Lead.



Primary form, an acute oblique rhombic prism, P : M=89° 36′, M : M=59° 40′. *Secondary form*, the plane ē truncates the front lateral edge. M : ē=119° 50′. *Cleavage* : basal, perfect; in traces in the direction of M and ē.

H.=2·5. G.=6·2—6·5. *Lustre* of the basal planes pearly, other parts resinous, somewhat adamantine. *Streak* white. *Color* white, passing into yellow, green, or gray. Transparent—translucent. Conchoidal *fracture* scarcely observable. Rather sectile.

Composition, according to Berzelius,

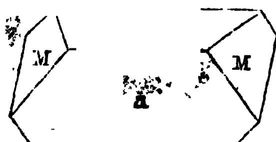
Carbonate of lead,	71·1
Sulphate of lead,	30·0=101·1

Before the blowpipe, it intumesces at first, and then turns yellow; but returns to a white color on cooling. Easily reduced. Effervesces briskly in nitric acid, and leaves a white precipitate.

Obs. This ore has been found principally at Leadhills, associated with other ores of lead, in a vein traversing graywacke; Grenada is also stated to be a locality of it. The crystals seldom exceed an inch in length, and are commonly smaller. The compound forms are very complex.

DIOXYLITE. Cronalus flexilis.

Prismatoidal Lead-Baryte, *M.* Sulphato-Carbonate of Lead, *Brooke*, Ed. Phil. Jour., iii, 117, Lanarkite.



Primary form, an oblique rhombic prism. *Secondary form*; plane M is usually rounded, and the crystals aggregated lengthwise and seldom distinct. *Cleavage* parallel to the shorter diagonal; Laminæ flexible like gypsum.

H.=2—2·5. G.=6·8—7. *Lustre* of the cleavage face, pearly;

other parts adamantine, inclining to resinous. *Streak* white. *Color* greenish-white, pale-yellow or gray. Transparent—translucent.

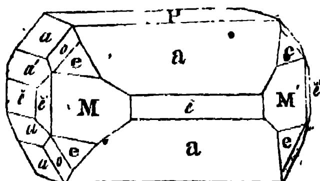
Composition, according to Brooke, Carbonate of lead 46·9, and sulphate of lead 53·1. Fuses before the blowpipe to a globule, which is white on cooling. Dissolves in nitric acid, but without a perceptible effervescence.

Obs. It occurs at Leadhills; with other ores of lead. A massive variety has been discovered in Siberia.

Dioxylite was named, in allusion to its containing two acids, from δις, *two*, and οξυς,

ANGLESITE. Cronalus prismaticus.

Prismatic Lead-Baryte, *M.* Sulphate of Lead. Lead Vitriol. Blei Vitriol.



Primary form, a right rhombic prism; M : M = 103° 49′. *Secondary form*, M : ē = 141° 54′, M : ĕ = 128° 6′, P : a = 140° 36′, P : e = 115° 40′, P : ē or ĕ = 90°. *Cleavage* parallel to M and P, but interrupted. The planes M and ē are often vertically striated, and a, horizontally. *Imperfect crystallizations:* lamellar and granular varieties are of frequent occurrence.

H.=2·75—3. G.=6·259—6·298. *Lustre* highly adamantine in some specimens, in others, inclining to resinous and vitreous. *Streak* white. *Color* white, tinged yellow, gray, green, and sometimes blue. Transparent—opaque. *Fracture* conchoidal. Very brittle.

Composition, according to Klaproth, (Beit. iii, 162,) Stromeyer, (Hoffman's Handbuch, iv, 43,) and Thomson (Min. i, 559,)

	Leadhills.		Leadhills.
Sulphuric acid,	25·75	26·0191	25·655
Protoxyd of lead,	70·50	72·9146	74·045
Protoxyd of iron,	——	0·1151	——
Protoxyd of manganese,	——	0·1654	——
Water,	2·25=98·5, K.	0·1242=99·3384, S.	0·300=100, T.

In the flame of a candle it decrepitates, and the surface frequently assumes a slightly reddish tinge. In powder, it melts in the blowpipe flame to a white slag, which yields metallic lead by the addition of carbonate of soda.

Obs. This ore of lead results, in many instances, from the decomposition of galena. At Leadhills it frequently occurs, occupying the cubical cavities of galena, or is disposed on the surface of this ore. This locality, and also Wanlockhead, afford large and beautiful crystals of this mineral, some of which are transparent, of a tabular form, and are several inches in diameter. Pary's mine in Anglesea, Mellanoweth in Cornwall, Clausthal and Zellerfeld in the Hartz, and Badenweiler in the Brisgau, are other localities. Small, but extremely perfect transparent crystals, have been brought from Fondon in Grenada. The massive varieties are met with in Siberia, Andalusia, and Alston Moor.

In the United States, it occurs in the Missouri lead mines, at the Wal. mine of Southampton, Mass., and of Rossie, N. Y., and with galena at the Walton gold mine, Louisa Co., Va.

HEDYPHANE. CRONALUS AMORPHUS.

Hedyphan, *Breit.* Schweig. J der Chem. iii, 1830.

Occurs in amorphous masses traversed by numerous fissures; also, according to Breithaupt, in short hexagonal prisms.

H.=3·5—4. G.=5·46—5·493. *Lustre* adamantine; sometimes subresinous. *Streak* and *Color* white, or grayish-white. Translucent.

Composition, according to C. Kersten, (Ann. de Ch. et de Ph. xlviii, 178,)

Protoxyd of lead,	52·950
Lime,	14·034
Chlorine,	2·029
Arsenic acid,	22·780
Phosphoric acid,	8·207=100

Fuses before the blowpipe to an opaque globule, which does not crystallize on cooling. Tinges the flame greenish-blue, without producing any odor. With salt of phosphorus it froths and gives out the odor of muriatic acid. Globules of lead are obtained on charcoal, and white arsenical fumes are given off. A scoria remains, which is not reducible in the interior flame, but crystallizes on cooling.

OBS. It occurs at Longbanshyttan in Sweden, associated with brown garnet and manganese spar. Its name is derived from ἡδυς, *sweet*, and φαίνειν, *to appear*.

PYROMORPHITE. CRONALUS HEXAGONUS.

Rhombohedral Lead-Baryte. Phosphate of Lead. Braunbleierz, Grünbleierz, *Wern.* and *Hoff.* Traubenblei, *Haus.*

Primary form, a hexagonal prism. *Secondary form*, fig. 125, Pl. II; M : *e*—150°, M : c=130° 22′, c : e=142° 12′. *Cleavage* in traces parallel to M. M commonly striated horizontally. *Imperfect crystallizations:* globular, reniform, and botryoidal forms, having a columnar structure; also fibrous and granular; grains strongly coherent.

H.=3·5—4. G.=6·5871—7·048. *Lustre* resinous. *Streak* white, sometimes yellowish. *Color* green, yellow, and brown, of different shades; sometimes fine orange-yellow, owing to an intermixture with chromate of lead. Subtransparent—subtranslucent. *Fracture* subconchoidal, uneven. Brittle.

Composition, according to Kersten, (Ann. de Ch. et de Ph. xlviii, 157,)

	Polysphærite, Freiberg.	Brown crystals, Mies.
Protox. lead,	72·17	[illegible]
Lime,	6·47	0·430
Chlorine,	2·00	1·909
Phosphoric acid,	19·36=100	16·331=100

Klaproth, (Beit. iii, 146,)

	Brown, Huel Goet.	Green, Zschopau.
Protox. of lead,	78·58	78·40
Muriatic acid,	1·65	1·70
Peroxyd of iron,	——	0·10
Phosphoric acid,	19·73=99·96	18·37=98·57

The variety Polysphærite occurs in small spheres of a brown color

Before the blowpipe on charcoal, it melts without addition, and the globule on cooling assumes a polyhedral form and a dark color In the reducing flame the globule becomes [illegible] Dissolves readily in heated nitric acid

Obs Pyromorphite occurs principally in veins, and accompanies other ores of lead

Fine specimens occur at Leadhills and Wanlockhead, at Poullaouen and Huel Goet in Brittany at Zschopau and other places in Saxony, in Bohemia, and at Sonnenwald near Freiberg

Pyromorphite has been found in fine specimens at the Perkiomen lead mine near Philadelphia, but it is not abundant also in Maine at the Lubec lead mines and the mine in Lenox in New York a mile south of Sing Sing, in Massachusetts sparingly at the Southampton lead mines Crystallizations of great beauty, presenting bright green and gray colors are obtained at the lead mine in Davidson Co, N C

The name *Pyromorphite* is from πυρ *fire*, and μορφη, *form*, and alludes to the crystalline form the globule assumes on cooling

MIMETENE CRONALUS ALLIACEUS

Brachytypous [illegible] Baryte, *M* Green Lead Ore Arseniate of Lead Grunbleierz, (in part) *W* [illegible] *Hai* Rhomboidal Lead Spar *Jam*

Primary form, a hexagonal prism *Secondary form*, the primary with the basal edges replaced, e e=142° 39, M e=129° 50'. *Cleavage* basal, imperfect, parallel with M in traces

H 2.75—3.5 G 6.41, Gregor. *Lustre* resinous *Streak* white *Color* pale yellow, passing into brown Subtransparent—translucent Sectile

Composition, according to Wohler (Pogg iv, 167)

	Johanngeorgenstadt	
Protoxyd of lead,	67 64	
Arsenic acid,	21 09	
Lead,	7 39	
Chlorine,	2 56	
Phosphoric acid,	1 32	100

Dissolves easily in nitric acid, especially if heated Before the blowpipe, in a gold spoon, it fuses to a brownish yellow mass, which does not crystallize externally on cooling On charcoal it gives out copious arsenical fumes, and affords a globule of lead

Obs Fine specimens of this mineral occur at Huel Unity, near Redruth in Cornwall and in several other of the Cornish mines, also at Beeralston in Devonshire At St Prix, in the department of the Saone, in France, it occurs in capillary crystals, at Johanngeorgenstadt, in fine crystals of a yellow color, at Nertschinsk, Siberia, in reniform masses of a brownish-red color

NUSSIERITE CRONALUS RHOMBOHEDRUS

Nussierite, *Danhauser* *G Barruel*, Ann de Chim et de Ph lxii, 217

Primary form, rhombohedral; stated to occur in very obtuse rhombohedrons, almost lenticular. It is generally found in implanted mammillary masses

H=4. G =5 0415 *Lustre* greasy, feeble *Streak* yellowish white—grayish, *Color* yellow, greenish, or grayish *Fracture* somewhat conchoidal

Composition, according to Barruel,

Silica,	7·20
Chlorid of lead,	7·65
Phosphate of lead,	56·40
Phosphate of lime,	22·20
Arsenate of iron,	6·50=99·95

The silica is stated to have been derived from the matrix. Barruel also supposes the chlorid of lead and arsenate of iron accidental, and the mineral to be a simple compound of phosphate of lead and phosphate of lime.

Before the blowpipe, on charcoal, it affords a whitish enamel; with borax it yields a yellowish glass. Dissolves easily in nitric acid without effervescence.

Obs. This mineral was discovered by M. J. Danhauser, at the mine of Nussière near Beaujeu, department of the Rhone, in France, where it occurs on quartz, associated with plumbo-resinite and Dreelite. It was named after its locality.

SELENATE OF LEAD. Cronalus seleniferus.

Kersten, Pogg. xlvi, 277.

In small spheres and botryoidal masses. *Cleavage* distinct in one direction.

H.=3—4. *Lustre* greasy—vitreous. *Streak*—powder, white. *Color* sulphur-yellow. Brittle. *Fracture* fibrous.

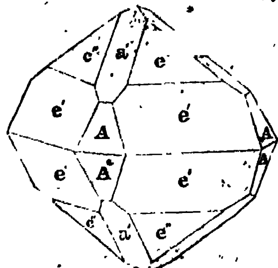
According to Rose's examination, it consists of selenic acid and oxyd of lead, with a small proportion of oxyd of copper. On coal it fuses readily to a black slag, giving off a strong selenium odor, and is finally reduced to a metallic globule. With borax it fuses and forms a yellowish-green pearl, which is of the same color on cooling. With soda, on charcoal, metallic lead is obtained.

Obs. Occurs with a selenid of antimony and lead, malachite, etc., at the Friederichsglück mine, near Hilburghausen.

MOLYBDATE OF LEAD. Cronalus pyramidalis.

Pyramidal Lead-Baryte, *M.* Gelb-bleierz, *Wern.* Yellow Lead Ore. Bleigelb, *Haus.* Bleimolybdat.

Primary form, a square octahedron; A : A (over a terminal edge)=99° 40′; A : A (over a basal edge) =131° 35′. *Secondary forms*, similar to fig. 54, Pl. I; also the annexed figure, e′ : e′ (over basal edge)=115° 7′, A : a′=150° 46′, e′ : e″=168° 49′, e″ : e″ (over a′)=118° 26′, e″ : e″ (over e′)=92° 43′. *Cleavage* very smooth parallel to A. It occurs also granularly massive; grains of various sizes, and firmly coherent.



Bleiberg.

H.=2·75—3. G.=5·706, Hatchett; 6·76, Haidinger. *Lustre* resinous. *Streak* white. *Color* wax-yellow, passing into orange-yellow; also siskin and olive-green, yellowish-gray, grayish-white. Subtransparent—subtranslucent. *Fracture* subconchoidal. Brittle.

Composition, according to Klaproth, (Beit. ii, 275,) Hatchett, (Phil. Trans. 1796, p. 233,) and Göbel, (Schweigger's Jahrbuch, vii, 71,)

bdic acid,	34·25	37·00	40·5
oxyd of lead,	64·42	58·40	58·0
d of iron,	—	3·08	—
	——=98·67, K.	0·28=98·76, H.	——=98·5, G.

A red variety contains a few per cent. of *chromic acid.*

In the blowpipe flame it decrepitates briskly, and becomes of a darker color, which color afterwards disappears. On charcoal it fuses and is absorbed, leaving behind globules of metallic lead. With borax in the exterior flame, it fuses readily to a colorless glass. In the interior flame, the glass is transparent, but on cooling becomes all at once dark and opaque. Melts readily with salt of phosphorus, producing a green glass, when the proportion of the mineral is small, but black and opaque, if large.

Obs. This species occurs in veins in limestone with other ores of lead, at Schwarzenbach, Bleiberg, and Windisch-Kappel in Carinthia. It is also met with at Retzbanya in Hungary, and at Moldawa in the Bannat, where its crystals are red and have considerable resemblance to chromate of lead.

It is found in small quantities at the Southampton lead mine, Mass., and at the Perkiomen mine near Philadelphia.

A *basic molybdate of lead* has been examined by Boussingault, from near Pamplona in South America.

VANADINITE. - Cronalus vanadiferus.

Vanadate of Lead. Vanadinbleierz.

Primary form, a hexagonal prism: occurs mostly in implanted globules or incrustations.

H.=2·75. G.=6·6623—7·23. *Lustre* of surface of fracture resinous. *Streak* white or yellowish. *Color* light brownish-yellow, straw-yellow, reddish-brown. Subtranslucent—opaque. *Fracture* even, or flat conchoidal. Brittle.

Composition, according to Berzelius, Chlorid of lead, 25·33, vanadate of lead 74·00, hydrous oxyd of lea 0·67, (Mexican variety.). Dr. R. D. Thomson obtained

Chlorine,	2·446
Lead,	7·063
Protoxyd of lead,	66·326
Vanadic acid,	23·436
Peroxyd of iron and silica,	0·163=99·434

Before the blowpipe, in a pair of forceps, it fuses, and retains its yellow color on cooling: if kept some time in fusion, however, it changes into a steel-gray porous mass, which, upon charcoal, yields globules of metallic lead. On charcoal it fuses with much frothing into a bead, resembling the original assay. It forms green solutions with the sulphuric and muriatic acids, and a beautiful yellow solution with nitric acid.

Obs. This mineral was first discovered at Zimapan in Mexico, by Del Rio. It has since been obtained among some of the old workings at Wanlockhead in Dumfriesshire, where it occurs in small globular masses, sprinkled over calamine, or forming thin coatings on the surface of that mineral, and also in hexagonal crystals.

T. Damour has described a "*zinciferous and cupriferous vanadate of lead*," (Ann. des M. xi, 161, 1837,) which is probably a mechanical mixture of this species with the oxyds of zinc and copper. It contains 6·345 of the former, and 2·960 of the latter.

TUNGSTATE OF LEAD. CRONALUS PONDEROSUS.

Dystomous Lead-Baryte, *M.* Tungstate of Lead. Scheelbleispath. Scheelsaures Blei. Bleischeelat

Primary form, a square octahedron; A : A=99° 43′ and 131° 30′, Levy. Occurs in modified square octahedrons or prisms; often indistinctly aggregated. *Cleavage* parallel to the base of the prism.

H.=2·75—3. G.=7·904—8·088. *Lustre* resinous. *Streak* white. *Color* green, gray, brown, and red. Faintly translucent.

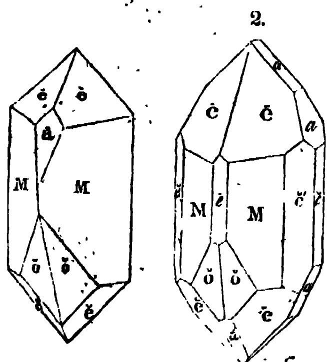
Composition. Tungstic acid 52, oxyd of lead 48.

It melts before the blowpipe, and gives off vapors of lead, leaving a dark-colored submetallic crystalline globule, having a pale-gray streak.

OBS. Tungstate of lead occurs at Zinnwald in Bohemia, associated with quartz and mica; also at Bleiberg in Carinthia, accompanying the molybdate of lead.

CHROMATE OF LEAD. CRONALUS HYACINTHUS.

Hemi-prismatic Lead-Baryte, *M.* Red Lead Ore. Crocoisite. Rothbleierz.



Primary form, an oblique rhombic prism; M : M=93° 40′, P : M=99° 11′. *Secondary forms,* P : ē=102° 20′, M : ē=136° 50′, M : ĕ=133° 10′, ē : ē=119°, ĕ : ĕ=107° 40′. *Cleavage:* lateral, tolerably distinct; basal, less so. Surface M streaked longitudinally. The faces mostly smooth and shining. *Imperfect crystallizations,* imperfectly columnar and granular.

H.=2·5—3. G.=6—6·004. *Lustre* adamantine-vitreous. *Streak* orange-yellow. *Color* various shades of hyacinth-red. Translucent. Sectile.

Composition of pure chromate of lead, Chromic acid 31·85, protoxyd of lead 68·15.

Blackens in the blowpipe flame, and decrepitates if quickly heated, but may be fused to a shining slag containing globules of lead. It undergoes a partial reduction in glass of borax, at the same time coloring it green. Dissolves without effervescence in nitric acid, and produces a yellow solution.

OBS. Siberia is the principal locality of the chromate of lead. It occurs also at Beresof in narrow veins, traversing decomposed gneiss, and associated with gold, pyrites, galena, quartz, and Vauquelinite. In Brazil, at Conconhas do Campo, fine crystallized specimens are met with, where it occurs in decomposed granite.

MELANOCHROITE. CRONALUS RUBEUS.

Subsesquichromate of Lead, *Thom.*

Primary form, a rhombic prism. Crystals usually tabular, and reticularly interwoven. Occurs also massive.

Very soft. G.=5·75. *Lustre* resinous, glimmering. *Streak* brick-red. *Color* between cochineal and hyacinth-red; becomes lemon-yellow on exposure. Subtranslucent—opaque.

Composition, according to Hermann, (Pogg. xxviii, 162,) Chromic acid 23·64, protoxyd of lead 76·36=100. The same result was obtained by G. Rose in a late analysis, (Leonh. 1839, 575.)

On charcoal, before the blowpipe, it fuses readily to a dark mass, which is crystalline when cold. In the reducing flame, lead is sublimed. It gives a green bead with the fluxes.

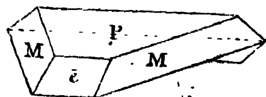
OBS. It occurs in a limestone rock at Beresofsk, in the Ural, associated with chromate of lead, Vauquelinite, pyromorphite, and galena. It was first analyzed and described by Hermann.

The name melanochroite is derived from μελας, *black*, and χροα, *color.*

VAUQUELINITE. CRONALUS VAUQUELINI.

Hemi-prismatic Melanochlor-Malachite, *M.*

Primary form, an oblique rhombic prism. Occurs usually in minute irregularly aggregated crystals, of a dark green or black color. *Compound crystals,* similar to the annexed figure; composition of *the third kind,* parallel to a plane on the acute solid angles, P : P (of the two individuals)=134° 30′, and P : *ē*=149° nearly. *Imperfect crystallizations:* reniform and botryoidal shapes, and granular structure; also amorphous.



H.=2·5—3. G.=5·5—5·78. External *lustre* adamantine, often faint. *Streak* siskin-green or brownish. *Color* dark-green, sometimes nearly black. Faintly translucent—opaque. *Fracture* uneven. Rather brittle.

Composition, according to Berzelius, Oxyd of lead 60·87, oxyd of copper 10·80, chromic acid 28·33=100.

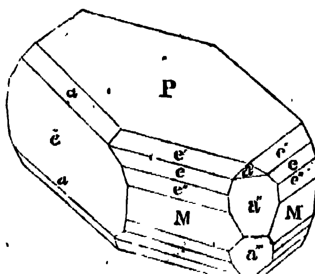
Before the blowpipe, on charcoal, it slightly intumesces and fuses to a gray submetallic globule, yielding at the same time, small beads of lead. It is partly soluble in nitric acid.

OBS. Vauquelinite occurs with chromate of lead at Beresof in Siberia, generally in mammillated or amorphous masses, or thin crusts. It has also been observed at Port Gibaud in the Puy de Dome; it is stated to occur along with the chromate of lead of Brazil. Levy gives its specific gravity at 6·8—7·2, and hardness above 4·0.

At the lead mine near Sing Sing, it has been found by Dr. Torrey in green and brownish-green mammillary concretions, and also nearly pulverulent.

CALEDONITE. CRONALUS DIATOMUS.

Paratomous Lead-Baryte, *Haid.* Cupreous Sulphato-Carbonate of Lead, *Brooke*, Ed. Phil. J. iii, 117. Halbazurblei.



Primary form, a right rhombic prism; M : M=95°. *Secondary form*, e′ : e′=108°, M : ĕ=132° 30′, P : a=126°, P : e′=126°, P : e=115° 30′, a″ : a″=143° 42′, Brooke. *Cleavage* parallel to M and P indistinct, more obvious parallel to ĕ. The crystals are sometimes large and well defined; but usually very minute, and occasionally appear in bunches diverging from a point.

H.=2·5—3. G.=6·4. *Lustre* resinous. *Streak* greenish-white. *Color* deep verdigris or bluish-green; inclining to mountain-green if the crystals are delicate. Translucent. *Fracture* uneven. Rather brittle.

Composition, according to Brooke, (Ed. Phil. J. iii, 119,)

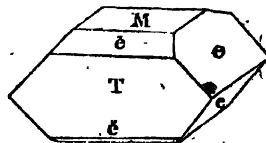
Sulphate of lead,	55·8
Carbonate of lead,	32·8
Carbonate of copper,	11·4=100

Easily reduced before the blowpipe.

OBS. It occurs only at Leadhills in Scotland, accompanying the other ores of lead at that locality.

CUPREOUS ANGLESITE. CRONALUS RHOMBOIDEUS.

Diplogenic Lead-Baryte, *Haid.* Cupreous Sulphate of Lead, *Brooke*. Bleilazur, Kupferbleispath. Linarit.



Primary form, a right rhomboidal prism; M : T=95° 45′, as determined by Haidinger. *Secondary form*, the annexed figure, e : e=119°, Haidinger. *Cleavage* very perfect parallel to M and T.

H.=2·5—3. G.=5·3—5·5. *Lustre* vitreous or adamantine. *Streak* pale blue. *Color* deep azure-blue. Translucent.

Composition, according to Brooke, (Ann. of Phil. 2d ser. iv, 117,) Oxyd of lead 75·4, oxyd of copper 18·0, and water 4·7=98·1. In the blowpipe flame, it affords indications of copper and lead.

OBS. This mineral occurs only at Leadhills, but is even there an exceedingly rare mineral. Linares in Spain, has been reported as another locality.

PLUMBO-RESINITE. CRONALUS RESINIFORMIS

Gummispath, *Br.* Sexaluminate of Lead, *Thomson*. Plombgomme. Bleigummi *of the Germans*.

Aggregations of columnar particles presenting externally reniform or globular shapes; also impalpable.

H.=4—4·5. G.=6·3—6·4. *Lustre* resinous. *Streak* white. *Color* yellowish and reddish-brown; also yellowish-white. Translucent. Resembles in color and appearance gum-arabic. *Fracture* conchoidal.

Composition, according to Berzelius and Dufrénoy, (Ann. de Ch. lix, 440,)

Protoxyd of lead,	40·14		37·51
Alumina,	37·00		34·23
Water,	18·80		16 14
Sulphurous acid,	0·20		——
Lime, ox. of iron and mang.	1·80	Phos. lead	7·80 (from the gangue.)
Silica,	0·60=98·54, B.		2·11=97·79, D.

A quick application of the heat of the blowpipe produces decrepitation, and it soon parts with the water it contains, but does not fuse. On charcoal it forms an enamel, like some of the zeolites, without fusing. With borax a colorless glass is obtained; a reduction of the ore is not effected. Concentrated muriatic acid decomposes the powdered plumbo-resinite.

OBS. It occurs in clay slate at Huelgoet, near Poullaouen, in Brittany, associated with galena, blende, iron pyrites, and pyromorphite; also in a lead mine near Beaujeu. It resembles some varieties of mammillated blende.

MINIUM. CRONALUS MINIUM.

Pulverulent, occasionally exhibiting, under the microscope, crystalline scales. The crystal, according to M. Kapper, is a right rhombic prism of 93° 44′.

G.=4·6. *Color* vivid red, mixed with yellow.

According to Mr. Smithson, it is a Sesquoxyd of lead. In the reduction flame of the blowpipe, globules of lead are obtained.

OBS. It occurs at Bleialf in Eifeld; Badenweiler in Baden; Brillon in Westphalia, island of Anglesey; and Grass-hill chapel, in Yorkshire. It is usually associated with galena, and also with calamine.

It is abundant at Austin's mines, Wythe Co., Va., along with white lead ore.

PLUMBIC OCHRE. CRONALUS OCHRACEUS.

Bleiglätte *of the Germans*

Occurs massive. G.=8·0. *Lustre* dull. *Streak* lighter than the color. *Color* between sulphur and lemon-yellow. Opaque. Does not soil.

Composition, according to Dr. John, Protoxyd of lead 87·382, carbonic acid 3·846, oxyd of iron and lime 0·181, ferruginous silica 2·404=94·113. Melts readily before the blowpipe, and is easily reduced.

OBS. It is said to occur at Baidenweiler in Baden, in quartz. Gerault states that it has been ejected from the volcanoes of Popocatapetl and Jztaccituall, in Mexico.

Occurs at Austin's mines, Wythe Co., Va.

SUPEROXYD OF LEAD.

The superoxyd of Lead has been met with at Leadhills. It consists of lead 86·62, and oxygen 13·38.

AZURITE. CYPRALUS CŒRULEUS.

Prismatic Azure-Malachite, *M.* Blue Copper Ore. Blue Carbonate of Copper. Blue Malachite. Hydro-Carbonate of Copper, *Thomson.* Chessy Copper. Kupferlasur.

Primary form, an oblique rhombic prism; M : M=98° 50′, P : M=91° 30′. *Secondary form,* P : ē=92 21′, a : ē=131° 56′, *a* : *a* (over P) =99 32′. *Cleavage:* lateral, perfect; basal, difficult. Also massive, and presenting imitative shapes, having a columnar composition; also dull and earthy.

H.=3·5—4·25. G.=3.5—3·831. *Lustre* vitreous, almost adamantine. *Streak* blue, lighter than the color. *Color* various shades of azure-blue, passing into azure and Berlin-blue. Transparent—subtranslucent. *Fracture* conchoidal. Brittle.

Composition, according to Klaproth, (Beit. iv, 31,) Vauquelin, (Ann. de Museum, xx, 1,) and Phillips, (Journ. Royal Institution, iv, 276.)

Carbonic acid,	24·00	21·25	25·46
Oxyd of copper,	70·00	70·00	69·08
Water,	6·00=100, K.	8·75=100, V.	5·46=100, P.

It blackens when strongly heated, and, on charcoal, fuses; borax is colored green. It dissolves with effervescence in nitric acid.

OBS. Azurite occurs abundantly in splendid crystallizations, presenting a great variety of forms and brilliant colors, at Chessy, near Lyons, whence it derived the name, *Chessy Copper.* It also occurs in fine crystals in Siberia; at Moldawa, in the Bannat: at Wheal Buller, near Redruth, in Cornwall; also in small quantities at Alston Moor and Wanlockhead.

This mineral occurs in indifferent specimens at the Perkiomen lead mine, associated with galena, blende, and white lead ore; also near Nicholson's gap, in the Blue Ridge, Penn., and near Sing Sing, N. Y.; near New Brunswick, N. J., in crystals coating the red shale.

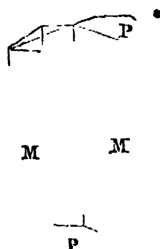
If abundant, blue malachite is a valuable ore of copper. When ground to an impalpable powder, it forms a blue paint of a bright tint; but it is of little value as a pigment, on account of its liability to turn green.

GREEN MALACHITE. CYPRALUS VULGARIS.

Hemi-Prismatic Habroneme-Malachite, *M.* Diprismatic Green Malachite, *Jameson.* Green Carbonate of Copper. Hydrous dicarbonate of Copper. Mountain Green. Atlaserz.

Primary form, an oblique rhombic prism; M : M=103° 42′, P : ē (plane truncating the front lateral edge) =118° 11′. *Cleavage:* basal, highly perfect; less distinct parallel to ē, or the shorter diag-

onal. *Compound crystals*, composition of the second kind; parallel with the obtuse lateral edge of the prism. *Imperfect crystallizations*, in fascicular groups; tuberose, botryoidal, and stalactitic shapes, composed of diverging fibres; also fibrous; frequently granular, or earthy.



H.=3·5—4. G.=4·008, Haidinger. *Lustre* adamantine, inclining to vitreous; fibrous varieties have often a silky lustre, and others are dull and earthy. *Streak* green, paler than the color. Translucent—subtranslucent—opaque. *Fracture* subconchoidal, uneven. Seldom observed in crystals.

Composition, according to Klaproth, (Beit. ii, 287.) and Vauquelin, (Hauy's Min. iii, 491.)

Carbonic acid,	18·0	21·25
Oxyd of copper,	70·5	70·00
Water,	11·5=100, K.	8·75=100, V.

Before the blowpipe, it decrepitates, becomes black, and is partly converted into a black scoria. With borax, it fuses easily to a deep green globule, and ultimately affords a bead of copper. Dissolves with effervescence in nitric acid.

Green malachite usually accompanies the other ores of copper. Perfect crystals are quite rare. The fibrous variety occurs abundantly in Siberia, at Chessy in France, and in the old mine at Sandlodge in Shetland; the compact occurs at Schwatz in the Tyrol; also at Cornwall. At the copper mines of Nischne Tagilsk, belonging to M. Demidoff, a bed of malachite was not long since opened, which it was supposed would yield 1000 cwt. of this ore; and among the specimens many were exceedingly splendid.

Neat specimens occur with vitreous copper at Cheshire, Connecticut; at Schuyler's mines, and still better at New Brunswick, New Jersey, where it is accompanied with red copper ore; between Newmarket and Taneytown, Md., east of the Monocacey; also in the Catoctin mountains, Md.; in the Blue Ridge in Pennsylvania, near Nicholson's Gap; near Morgantown, Penn., in beautiful specimens; at the Perkiomen lead mine; and in abundance at the copper mines of Wisconsin, at Mineral Point, and elsewhere.

Green malachite admits of a high polish, and when in large masses, is cut into tables, snuff-boxes, vases, &c. It is the principal ore that is worked for copper in the Wisconsin

MYSORIN. CYPRALUS FUSCUS.

Massive.

G.=2·62. Soft. *Color* blackish-brown, when pure; usually green or red, from mixture with malachite and red oxyd of iron. *Fracture* conchoidal.

Composition, according to Thomson, Carbonic acid 16·70, oxyd of copper, 60·75, peroxyd of iron (mechanically mixed) 19·50, silica 2·10, loss 0·95.

Gives no water in a glass tube.

OBS. Occurs at Mysore in Hindostan.

AURICHALCITE. CYPRALUS ZINCIFERUS.

Aurichalcit, *Böttger*, Pogg. xlviii, 495. Green Calamine, *Patrin*.

In acicular crystals forming drusy incrustations; also columnar and granular.

H.=2. *Lustre* pearly. *Color* verdigris-green. Translucent.

Composition, according to Böttger,

Oxyd of copper 28·1920, oxyd of zinc 45·8388, carbonic acid 16·0560, water 9·9505—100·0573.

Before the blowpipe, in a glass tube, gives out water, which has neither acid nor alkaline reaction, and the green crystals become brownish-black. In the oxydation flame, the color becomes darker, but does not fuse; in the reduction flame, forms a slag without melting, yellow while hot, and white on cooling. With borax and salt of phosphorus, intumesces and affords a green glass. With equal quantities of soda and borax, becomes reduced, affording a globule of copper in a slag of zinc oxyd.

Obs. Aurichalcite occurs at Loktewsk, at the copper mine of Altai, where it is associated with calc spar and brown iron ore, sometimes forming a drusy covering upon these minerals: also near Kleopinski, (Patrin's Green Calamine,) in drusy cavities.

CHRYSOCOLLA. CYPRALUS AMORPHUS.

Kieselmalachite. Euchromatic Opaline-Allophane, *M.* Copper-green Silico-Carbonate of Copper, *Thomson.*

Botryoidal and massive.

H.=2—3. G.=2—2·238. *Lustre* vitreous, shining, earthy. *Streak* white. *Color* emerald and pistachio-green, passing into sky-blue; often brown when impure. Translucent—opaque. *Fracture* conchoidal. Rather sectile; translucent varieties brittle.

Composition, according to Klaproth, (Beit. iv, 34.) John, and Thomson,

Silica,	26	28·37	25·31
Oxyd of copper,	50	49·63	51·16
Carbonic acid,	07	3·00	14·98
Water,	17	17·50	5·25
Sulphate of lime,	——=100, K.	1·50—100, J.	——=100, T.

"The great difference in the proportion of carbonic acid in these analyses, renders it probable that the carbonate and silicate of copper are not chemically combined." Thomson.

Blackens in the interior flame of the blowpipe on charcoal, without melting. With borax it melts to a green glassy globule, and is partly reduced.

Obs. The same specimen of this mineral often presents very different appearances at its opposite parts; being sometimes of an earthy appearance, like decomposed feldspar, in one part, and translucent and brittle on the opposite. The differences of the several varieties are owing, more or less, to impurities.

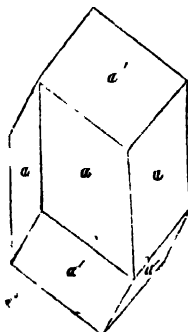
It accompanies other copper ores in Cornwall; at Libethen in Hungary; at Falkenstein and Schwatz in the Tyrol; in Siberia, the Bannat, Thuringia, &c.

In Sommerville and Schuyler's mines, New Jersey, at Morgantown, Pa., and at Wolcottville, Conn., chrysocolla occurs, associated with red copper ore, native copper, and green malachite; also with similar associated minerals and with brown iron ore in Nova Scotia, at the Basin of mines.

A *Bisilicate of Copper* is described by Bowen as investing the impure ores of copper at the Schuyler, Franklin, and the Bridgewater mines, and also occurring in veins or masses in the rock. The color varies from mountain-green to a deep bluish-green. Fracture uneven or somewhat conchoidal. Brittle. Usually opaque and dull, but sometimes translucent and vitreous in lustre. When powdered and slightly heated in a platina crucible, it becomes reddish, and finally, with more heat, black. It consists, according to Beck, of Oxyd of copper 42·60, silica 40·00, oxyd of iron 1·40, water and loss 16·00=100. A specimen from the Bridgewater mine gave 37 per cent. of silica. (L. C. Beck, Silliman's Journal, xxxvi, 111.)

DIOPTASE. CYPRALUS RHOMBOHEDRUS.

Rhombohedral Emerald-Malachite, *M.* Emerald Copper. Achirite. Smaragdo-Chalcit, *Br.*



Primary form, an obtuse rhombohedron; R : R=126° 17′. *Secondary form*, fig. 118, *a′* : *a′* =95° 48′, *a′* : *a*=132° 6′, *a* : *a*=120°. *Cleavage* perfect, parallel with R.

H.=5. G.=3·278. *Lustre* vitreous—inclining to resinous. *Streak* green. *Color* emerald-green; also blackish-green and verdigris-green. Transparent—subtranslucent: *Fracture* conchoidal, uneven. Brittle.

Its *composition* has been determined very differently by different chemists. It contains, according to Lowitz, (Nova Acta Petrop. xiii,) Vauquelin. (Ferussac Bull. 1825, p. 196,) and Hess, (Mém. par Berthier, ii, 261,)

Oxyd of copper,	55	25·57	45·10
Silica,	33	28·57	36·85
Water,	12	——	11·52
Carbonate of lime,	—	12·85	Lime, 3·39
Alumina,	—	——	2·36
Magnesia,	—=100, L.	——=96·99, V.	0·22=99·44, H.

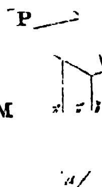
Decrepitates in the blowpipe flame, tinging it yellowish-green; in the exterior flame it becomes black, and in the interior, red, but does not melt. It fuses with borax, giving it a green color, and finally is reduced. Insoluble in nitric, but soluble without effervescence in muriatic acid. It acquires negative electricity by friction when insulated.

Obs. Dioptase occurs disposed in well defined crystals on quartz, in the Kirghese Steppes of Siberia, whence it was first brought by a Bucharian merchant, Achir Mamed. It was named Achirite, after this merchant. It is said to occur at Retzbanya in Hungary, associated with electric calamine.

The name dioptase is from δια, *through*, and ʼοπτομαι, *to see.*

EUCHROITE. CYPRALUS SPECIOSUS.

Prismatic Emerald Malachite, *M.* Euchroite, *Breithaupt.*



Primary form, a right rhombic prism; M : M =117° 20′. *Secondary form*, P : *a*=133° 56′, *ẽ* : *a*=136° 4′, M : *ẽ*=121° 20′. *Cleavage* lateral, distinct. Faces M vertically striated.

H.=3·75. G.=3·389. *Lustre* vitreous. *Streak* pale apple-green. *Color* bright emerald-green. Transparent—translucent. Doubly refracts distinctly. *Fracture* small conchoidal—uneven. Rather brittle.

Composition, according to Dr. Turner, (Schweig. Jahrb. xv, 233,)

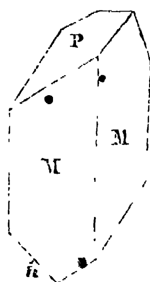
Oxyd of copper,	47·85
Arsenic acid,	33·02
Water,	18·80=99·67

In the matrass, it loses water, and becomes yellowish-green and friable. Heated on charcoal to a certain point, it is reduced in an instant with a kind of deflagration, leaving a globule of malleable copper, with white metallic particles disseminated throughout the mass, which volatilize with the continuance of the heat.

OBS. It occurs in quartzose mica slate at Libethen in Hungary, in crystals of considerable size, having much resemblance to dioptase. Its name is derived from ευχροα, *beautiful color.*

APHANESITE. CYPRALUS ACROTOMUS.

Diatomous Habroneme-Malachite, *M.* Axotomous Habroneme-Malachite, *Haid.* Radiated Acicular Olivenite, *Jam.* Strahlerz, *Hoff.* Cuivre Arseniaté Ferritère, *H.* Cuivre Arseniaté en Prism Rhomboidale Oblique, *Levy.* Strahlenkupfer, Siderochalcit, *Br.*



Primary form, an acute oblique rhombic prism; M : M=56°, P : M=85°. *Secondary form*, M : M =124°, P : ă=99° 30′. *Cleavage* basal, highly perfect.

H.=2·5—3·0. G.=4·192. *Lustre* of face P pearly. *Streak* verdigris-green. *Color* dark verdigris-green, inclining to blue; also dark blue. Subtranslucent. Not very brittle.

Composition, according to Chenevix and Richardson,

Oxyd of copper,	54·00	56·65
Arsenic acid,	30·00	39·80
Water,	16·00—100, C.	3·55—100, R.

It deflagrates before the blowpipe, fuses readily, and emits arsenical fumes.

OBS. It occurs only at Cornwall, with other salts of copper. The crystals usually present a very dark blue color and brilliant lustre, but are rarely recognizable, being aggregated in diverging groups, or disposed in extremely minute individuals, in cavities of quartz. Hence the name *aphanesite*, from 'αφανης, *unmanifest.*

ERINITE. CYPRALUS CONCENTRICUS.

Monotomous Dystome-Malachite, *M.* Hydrous Sub-bisesquiarseniate of Copper, *Thomson.*

Occurs in mammillated crystalline groups, consisting of concentric coats of a fibrous structure, and presenting rough surfaces, arising from the terminations of very minute crystals. The layers, which are themselves very compact, are often easily separable. They sometimes present indistinct traces of what appears to be a rectangular cleavage.

H.=4·5—5. G.=4·043. *Lustre* almost dull, slightly resinous. *Streak* green, paler than the color. *Color* a fine emerald-green, slightly inclining to grass-green. Subtranslucent—nearly opaque. Brittle.

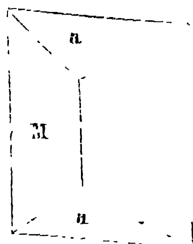
Composition, according to Dr. Turner, (Phil. Mag. 2d ser. iv, 151,

Oxyd of copper,	59·44
Arsenic acid,	33·78
Alumina,	1·77
Water,	5·01—100

OBS. Erinite occurs associated with other arsenates of copper, in the county of Limerick, Ireland. It was first described by Haidinger, and named from *Erin*, in allusion to its occurring in Ireland.

LIROCONITE. CYPRALUS RECTANGULUS.

Prismatic Lirocone-Malachite, *M.* Prismatic Olivenite, or Lenticular Copper, *Jam.* Octahedral Arseniate of Copper. Linsenerz, *Wern.* Linsenkupfer, *Haus.* Cuivre Arseniaté Octaèdre obtus, *H.*



Primary form, a rhombic prism; M : M=119° 45′. *Secondary form*, a : a=71° 59′. *Cleavage* lateral, but obtained with difficulty. Granular varieties occur, but are rare.

H.=2—2·5. G.=2·882, Bournon; 2·926, Haidinger. *Lustre* vitreous, inclining to resinous. *Streak* and *Color* sky-blue—verdigris-green. *Fracture* imperfectly conchoidal, uneven. Imperfectly sectile.

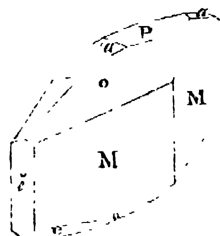
Composition, according to Chenevix, Oxyd of copper 49, arsenic acid 14, water 35=98. An analysis by Thomson of some pure crystals, though unsatisfactory, as he states, on account of the small quantity employed, gives a very different composition; according to him, it consists of Oxyd of copper 30·10, arsenic acid 43·39, water 26·69=100·18.

Before the blowpipe it loses its color and transparency, emits arsenical fumes, and becomes a black, friable scoria, containing some white metallic globules. With borax, it affords a green globule, and undergoes a partial reduction. Dissolves in nitric acid without effervescence.

OBS. Crystals of this mineral have occasionally been observed an inch in diameter; usually they are quite small. It occurs, associated with various ores of copper, pyrites, and quartz, at Huel Gorland and Huel Unity, in Cornwall; also in minute crystals at Herrengrund in Hungary.

PSEUDO-MALACHITE. CYPRALUS HEMIHEDRUS.

Hemi-prismatic Dystome-Malachite, *M.* Prismatic Olivenite. Phosphate of Copper. Hydrous Phosphate of Copper. Phosphorchalcit.



Primary form, an oblique rhombic prism; M : M=38° 56′. *Secondary form*, P : e=90°, M : M=141° 4′, the supplement of 38° 56′, M : e=109° 28′. *Cleavage* in indistinct traces parallel to e or the shorter diagonal; also it is stated parallel to P. *Imperfect crystallizations:* reniform shapes and massive, indistinctly fibrous, and having a drusy surface.

H.=4·5—5. G.=4·205. *Lustre* adamantine, inclining to vitreous. *Streak* green, a little paler than the color. *Color* emerald, verdigris, or blackish-green, often darker at the surface. Translucent—subtranslucent. *Fracture* small conchoidal—uneven. Brittle.

Composition, according to Klaproth, (Beit. iii, 201,) and Lunn, (Ann. Phil. 2d ser. iii, 179,)

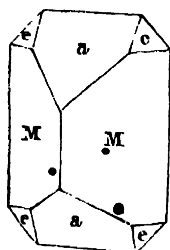
Oxyd of copper,	68·13	62·847
Phosphoric Acid,	30·95	21·687
Water,	——=99·08, K.	15·454=99·988, L.

Fuses readily in the blowpipe flame, to a small vesicular metalloidal globule. Dissolves without effervescence in nitric acid; more readily if heated.

OBS. Pseudo-malachite occurs in veins traversing gray-wacke slate at Rheinbreitenbach, near Bonn, on the Rhine, and is associated with quartz and other ores of copper. The massive variety is met with at Libethen in Hungary.

LIBETHENITE. CYPRALUS DYSTOMUS.

Diprismatic Olive-Malachite, *M.* Prismatic Olivenite. Phosphate of Copper. Hydrous Diphosphate of Copper, *Thom.* Cuivre Phosphaté, *H.* Phosphatischer Olivenchalcit, *Br.* Ehlit.



Primary form, a right rhombic prism; M : M =95° 2′. *Secondary form*, a : a (over the apex) =111° 58′. *Cleavage* very indistinct parallel to M and a.

H.=4. G.=3·6—3·8. *Lustre* resinous. *Streak* olive-green. *Color* olive-green, generally dark. Subtranslucent. *Fracture* conchoidal—uneven. Brittle.

Composition, according to Berthier, (Ann. des Mines, viii, 334,)

Phosphoric acid,	28·7
Oxyd of copper,	63·9
Water,	7·4=100

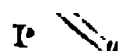
On the first impression of the heat of the blowpipe, it fuses to a brownish globule, which, by further action, acquires a reddish-gray color and metallic lustre, and ultimately yields at its centre, a globule of metallic copper.

OBS. It occurs in cavities in quartz, associated with copper pyrites at Libethen, near Neusohl, in Hungary; also in small quantities near Gunnislake in Cornwall.

Kuhn has analyzed a phosphate of copper (Ann. der Phar. xxxiv, 218) from Hirschberg in Russian Voigtland, consisting of Oxyd of copper 71·73, phosphoric acid 20·87, water 7·40. It occurs in nodules composed of concentric fibrous coats, and resembles malachite in color. It is associated with brown iron stone in veins of quartz.

OLIVENITE. CYPRALUS ACICULARIS.

Prismatic Olive-Malachite, *M.* Acicular Olivenite. Prismatic Arseniate of Copper, *Bournon.* Prismatic Oliven Ore. Olivenit, *L.*







Primary form, a right rhombic prism; M : M =110° 50′. *Secondary form*, P : *a*=136° 15′, M : *ě*=124° 35′. *Cleavage* in traces parallel to M and *a*, the former a little the most distinct. *Imperfect crystallizations:* globular and reniform shapes, indistinctly columnar, fibres straight and divergent, rarely promiscuous; also fibrous, curved lamellar and granular.

H.=3. G.=4·2809, Bournon; 4·166, Richardson. *Lustre* adamantine—vitreous; of some fibrous varieties, pearly. *Streak* olive-green—brown. *Color* various shades of olive-green, passing into leek-, siskin-, pistachio-, and blackish-green; also liver-, and wood-brown. Substransparent—opaque. *Fracture* when observable, conchoidal—uneven. Brittle.

Composition, according to Kobell, (Pogg. xviii. 249,) and Richardson, (Thom. Min. i. 614,)

Arsenic acid,	36·71	39·9
Oxyd of copper,	56·43	56·2
Water,	3·50	3·9
Phosphoric acid,	3·36=100, K.	——=100, R.

Remains unaltered before the blowpipe alone, but on charcoal it fuses with a kind of deflagration, and yields a white metallic globule, which, as it cools, becomes covered with a red scoria. It dissolves in nitric acid.

Obs. The crystallized varieties occur disposed on, or coating cavities of quartz, at the Cornwall mines; also in inferior specimens at Alston Moor. *Wood arsenate*, is a term which has been applied to a variety presenting a soft velvet-like surface, and a light siskin or greenish-gray color, having an earthy texture, and a radiated or fibrous structure. It is peculiar to Cornwall.

ATACAMITE. CYPRALUS EXHALANS.

Prismatoidal Habroneme-Malachite, *M.* Hexmuriate of Copper, *Thomson.* Smaragdochalcite, *Haus.*

Primary form, a right rhombic prism; M : M=107° 10′. *Secondary forms*, a rectangular octahedron, common with the minute crystals; also highly modified rectangular prisms. *Cleavage* basal, perfect; lateral, less distinct.

H.=2·5—3. G.=4·43. *Lustre* adamantine—vitreous. *Streak* apple-green. *Color* various shades of green, sometimes blackish-green. Translucent—subtranslucent.

Composition, according to Proust, (Ann. de Chim. xxxii, 49,) and Klaproth, (Beit. iii, 200,)

Oxyd of copper,	76·595	73·0
Muriatic acid,	10.638	10·1
Water,	12·767=100, P.	16·9=100, K.

Tinges the blowpipe flame a bright green or blue, and gives off fumes of muriatic acid; on charcoal, the copper is reduced to the metallic state.

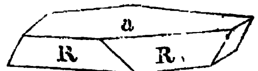
Obs. This species was originally found in the state of sand in the Atacama desert, between Chili and Peru. It is said to occur also at Remolinos, in Chili, and in veins in the district of Tarapaca. It also invests some of the lavas of Vesuvius, being formed by the action of the volcano; Schwarzenberg in Saxony, is another reported locality.

It is ground up in Chili, and sold under the name of *Arsenillo*, as a powder for letters.

COPPER MICA. CYPRALUS FOLIACEUS.

Rhombohedral Euchlore-Malachite, *M.* Prismatic Copper Mica, *J.* Rhomboidal Arsenate of Copper, *P.* Kupfer Glimmer, *W.* and *L.* Terhydrous Diarsenate of Copper, *Thom.* Kupferphyllit, *Br.*

Primary form, an acute rhombohedron; R : R=68° 45′. *Secondary form*, R : a=108° 40′. *Cleavage* highly perfect parallel to the plane a, which is sometimes striated in triangular directions. It is said also to occur massive.



H.=2. G.=2·5488, Bournon. *Lustre* of a, pearly; of the other faces, vitreous. *Streak* somewhat paler than the color. *Color* emerald or grass-green. *Fracture* scarcely observable. Sectile.

Composition, according to Vauquelin and Chenevix,

Oxyd of copper,	39	58
Arsenic acid,	43	21
Water,	17=99, V.	21=100, C.

It decrepitates in the blowpipe flame, loses its color and transparency, emits arsenical fumes, and fuses to a black globule, after forming a black spongy scoria.

OBS. The copper mines of Tingtang, Wheal Gorland and Wheal Unity, near Redruth, are its principal localities in Cornwall. It is stated to have been observed in minute crystals at Herrengrund in Hungary.

COPPER FROTH. CYPRALUS DECREPITANS.

Prismatic Euchlore-Malachite, *M.* Cupriferous Calamine, *P.* Zinc Hydraté Cuprifère, *Levy.* Kupferschaum. Copper Schaum, and Hydrous Sub bisesquiarseniate of Copper, *Thom.* Bordiglione. Pharmacosiderite. Kupaphrite.

Primary form, a right rhombic prism. *Secondary form*, the primary, with the acute lateral edges truncated. *Cleavage* basal, perfect. Surface M with horizontal striæ.

H.=1—1·5. G.=3·098. *Lustre* of P, pearly; of other faces, vitreous. *Streak* a little paler than the color. *Color* pale apple-green and verdigris-green, inclining to sky-blue. Translucent—subtranslucent. *Fracture* not observable. Very sectile. Thin laminæ flexible.

Composition, according to Kobell, (Pogg. xviii, 253,)

	Falkenstein, Tyrol.	
Arsenic acid,	25·01	25·366
Oxyd of copper,	43·88	43·660
Water,	17·46	19·824
Carbonate of lime,	13·65=100	11·150=100

Decrepitates briskly in the blowpipe flame, throwing off fine fragments which tinge the flame green, blackens, and fuses to a steel-gray globule, not crystalline on its surface. On charcoal, it emits moisture quietly, and after a long continuance of the blowpipe heat, swells a little from the extrication of the vapor of arsenic. With soda, an imperfectly fluid mass is obtained, which contains a white metallic nucleus.

OBS. This mineral usually occurs in the cavities of calamine, calc spar, or quartz, accompanied by other ores of copper, appearing in small aggregated and diverging fibrous groups of a pale-green color, and possessing a delicate silky lustre. It has been observed in the Bannat; at Libethen in Hungary; Nerzschinsk in Siberia; Schwartz in the Tyrol; Saalfield in Thuringia; and at Matlock in Derbyshire.

CONDURRITE.

Massive; compact or earthy.

Soft. G.=5·20. *Color* brownish-black, or inclining to blue. *Fracture* flat conchoidal.

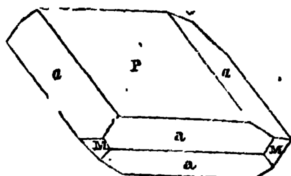
Composition. Arsenic acid 26·58, oxyd of copper 63·78, water 9·64.

In a glass tube, it yields water and a crystallized sublimate of arsenic acid. On charcoal it is reduced to an arsenate of copper.

OBS. Occurs at the Condurra mine in Cornwall, England, associated with other ores of copper.

BROCHANTITE. CYPRALUS BROCHANTIANUS.

Prismatic Dystome-Malachite, *M.* Brochantit, *Levy*, Ann. of Phil. viii, 241, 1824. Konigine.



Primary form, a right rhombic prism; M : M=114° 20′. *Secondary form*, P : a=148° 30′, a : a (over P)=117°, a : a (adjacent planes)=150° 30′, P : a=104° 45′. Surface M blackish and dull. *Cleavage* lateral, in traces. H.=3·5—4. G.=3·7—3·8. *Lustre* vitreous. *Color* emerald-green. Transparent.

Composition, according to Children, (Ann. of Phil. 2d ser. viii, 241.) Sulphuric acid, oxyd of copper, and a little silica, or alumina. It dissolves in muriatic acid, and blackens before the blowpipe, without fusing.

A mineral from Retzbanya, in Hungary, analyzed by G. Magnus, of Berlin, appears to be closely allied to this species. He obtained for its composition, Sulphuric acid 17·426, oxyd of copper, 66·935, water 11·917, oxyd of tin 3·145, oxyd of lead 1·048. With this species must also be united the *Konigine* of Levy.

OBS. It occurs in small but well defined crystals, with malachite and native copper, at Katherinenburg in Siberia. The Konigine was found at the same locality.

Brochantite was named by Levy in honor of Brochant de Villiers.

VOLBORTHITE. CYPRALUS VANADIFERUS.

Hess, Bulletin of the Imp. Ac. Sci. of St. Petersburg, iv, No. 2.

In small aggregated globules. Scratches calc spar. G.=3·55. *Lustre* vitreous. *Color* olive-green. *Streak* clear yellowish-green, nearly yellow. Thin splinters, transparent—translucent.

In a glass tube before the blowpipe it gives off some water, and blackens, without further change. On charcoal it fuses readily without intumescence, and finally forms a graphite-like slag, which does not fuse to a globule. Affords a chrome-green globule with borax. With salt of phosphorus and a little of the mineral, on platina, it forms a pearl, which is yellow in the oxydation flame, and green in the reduction flame. It is a vanadate of copper.

OBS. Volborthite was first discovered by Volborth, with copper ores, in the collection of Dr. Rauch, and is supposed to have come from the mines between Miask and Katharinenberg.

BEAUMONTITE.

Native crenated hydrosilicate of Copper, *Jackson*, Silliman's Jour. xxxvii, 398.

Amorphous, looking like clay. Soft. *Color* bright blue, become green on exposure.

Composition, according to Jackson, Silica 21·0, oxyd of copper 46·8, crenic acid 15·8, water 10·0, alumina and oxyd of iron 4·4, carbonic acid 2·0=100. Appears to be a mechanical mixture of silicate and crenate of copper, with some alumina and iron.

OBS. This species was detected by Dr. C. T. Jackson among some copper ores from the Chessy copper mines in France, and named in honor of Prof. L. Elie de Beaumont

VELVET COPPER ORE

Cuivre Velouté, *Levy* Kupfersammterz

Occurs in spherical globules or in druses consisting of short delicate fibres, and having an appearance like velvet. *Color* fine smalt-blue. *Lustre* pearly.

OBS It occurs sparingly at Moldawa in the Bannat, coating the cavities of an earthy oxyd of iron According to Brooke, it contains silica, oxyd of copper, sulphuric acid, and oxyd of zinc

NICKEL GREEN NICCALIS PRASINI

Diarsenate of Nickel *Thom* Nickelöcker and Nickelblüthe *of the Germans*

In capillary crystals , also massive

Soft *Color* fine apple green. *Streak* greenish-white *Fracture* uneven, or earthy

Composition, according to Berthier, (Ann de Ch et de Ph xiii, 56)

	Allemont
Arsenic acid,	36 8
Oxyd of nickel,	36 2
Water,	24 5
Oxyd of cobalt,	2 5=100

Darkens in color before the blowpipe On charcoal it gives out the odor of arsenic, and in the inner flame of the blowpipe yields a metallic button

OBS It occurs on white nickel at Allemont in Dauphiny, and is supposed to result from the decomposition of this ore also at Kamsdorf near Saalfeld, and at Reichelsdorf It has been occasionally observed associated with copper nickel in the cobalt mine at Chatham, Connecticut

URANIC OCHRE URANAIUS OCHRACEUS

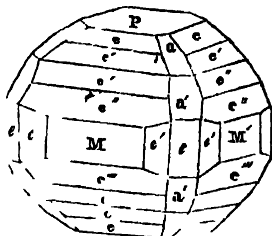
Earthy and pulverulent *Color* sulphur-yellow, citron-yellow to brownish or reddish-yellow. When gently heated, it becomes orange yellow

It is believed to be Oxyd of uranium, combined sometimes with carbonic acid It dissolves in acid, yielding a yellow solution, which affords a brown precipitate with prussiate of potash

OBS. It accompanies pitchblende in Cornwall and in Bohemia At the Callington tin mine, Cornwall, it has been observed in masses of considerable size, which were quite free from carbonic acid It is found sparingly with columbite and uranite at the Feldspar quarry near Middletown, Ct

URANITE. Uranaius quadratus.

Pyramidal Euchlore-Malachite, *M.* Pyramidal Uranite, *J.* Uran Mica. Cupreo-phosphate of Uranium, *Thom.* Chalcolite Uranglimmer, *W.* Uranoxyd, *Haus.* Urane Oxydé, *H.* Uranphyllit.



Primary form, a right square prism. *Secondary,* similar to figs. 52 and 53, Pl. I; also the annexed figure, P : e=145° 32′, P : e′=140° 40′, P : e″=137° 10′, P : e‴=111° 50; P : a′=134°, Phillips. *Cleavage* parallel to P highly perfect; traces of *e.* Surface P smooth, M rough.

Lustre of P pearly, of other faces adamantine. Transparent—subtranslucent. *Fracture* not observable. Sectile. Laminæ brittle and not flexible. In this respect this mineral differs from green varieties of mica, which it sometimes resembles.

Var. 1. URANITE. Var. calciferus.

Lime Uranite. Kalk Uranite.

H.=2—2·5. G.=3·05—3·19. *Color* citron to sulphur-yellow.

Composition, according to Berzelius, (K. V. Ac. H. 1823, p. 174,)

Phosphoric acid,	14·96
Oxyd of uranium,	64·03
Lime,	5·97
Water,	15·04=100

Fuses, before the blowpipe, to a blackish mass like pitch-blende.

Obs. Uranite is found with other ores of uranium, associated with silver, tin, and iron ores.

This mineral was discovered by M. Champeau at St. Symphorien, near Autun, in veins passing through granite. It also is found near Limoges and elsewhere.

It occurs sparingly at the Middletown feldspar quarries, associated with columbite and pitchblende, in minute tabular crystals, and thin scales of light green and lemon-yellow colors; also in minute crystals at Chesterfield, Mass., on the quartz or albite, and sometimes in the red centres of tourmalines, where it was detected by Mr. Teschemacher. The colors are straw-yellow and light-green.

Var. 2. CHALCOLITE. Var. cupriferus.

Chalcolite-Uran glimmer, *W.* Copper Uranite.

H.=2—2·5. G.=3·5—3·6. *Color* emerald and grass-green, and sometimes leek, apple, and siskin-green. *Streak* somewhat paler than the color.

Composition, according to Berzelius, (K. V. Ac. H. 1823, p. 174,)

Phosphoric acid,	14·62	15·57
Oxyd of uranium,	62·52	60·31
Oxyd of copper,	8·12	8·44
Water,	14·74=100	15·05=99·37

Fuses before the blowpipe to a black mass, coloring the flame bluish-green. Gives with borax a green glass, which becomes reddish-brown in the reduction flame.

Obs. Gunnis lake formerly afforded splendid crystallizations of this species, and also Tincroft and Wheal Buller, near Redruth in Cornwall.

CARBONATE OF SILVER. Argentalus cinereus.

Massive and incrusting, or earthy. Very soft. *Lustre* weak or earthy. *Color* ash-gray to black.

Composition, Oxyd of silver 84·00, carbonic acid 16·00=100. Easily reduced.

Obs. Occurs with other ores of silver at Wolfach in Baden, and at Real de Catorce in Mexico.

ORDER III. CERATINEA.

HORN SILVER. Ceratus cubicus.

Hexahedral Pearl-Kerate, *M.* Muriate of Silver. Chlorid of Silver. Hornerz, *Wern.*, *Hoff.* Hornsilber, *Haus.* Argent Muriaté, *H.*

Primary form, the cube. *Secondary forms*, figs. 2, 3, 4, 5, 6, 7, Pl. I. *Cleavage* none. *Imperfect crystallizations*, usually massive; rarely columnar, or bent columnar; often in crusts.

H.=1—1·5. G.=5·552. *Lustre* resinous, passing into adamantine. *Streak* shining. *Color* pearl-gray, passing into lavender, and violet-blue; also into grayish-, yellowish-, and greenish-white, and into siskin-, asparagus-, pistachio-, and leek-green. Becomes brown on exposure. Translucent—feebly subtranslucent. *Fracture* more or less perfectly conchoidal. Sectile.

Composition, according to Klaproth, (Beit. i, 132, and iv, 10,)

	Saxony.	Peru.
Silver,	67·75	76
Muriatic acid,	27·50	24
Oxyd of iron,	6·00	—
Alumina,	1·75	—
Sulphuric acid,	0·25=103·25	—=100

Fuses in the flame of the candle, with an emission of fumes of muriatic acid. On charcoal it is easily reduced; and if rubbed with a plate of moistened zinc or iron, the surface of zinc or iron becomes covered with a thin film of metallic silver. Not soluble in nitric acid or water.

Obs. Horn silver occurs in veins of clay slate, accompanying other ores of silver, and usually only in the higher parts of these veins. It has also been observed with ochreous varieties of brown iron ore; also with several copper ores, calc spar, heavy spar, &c.

The largest masses, and particularly those of a green color, are brought from Peru and Mexico, where it occurs with native silver. In Chili it is the most abundant ore of silver. At Chanaveillo veins one to two inches thick are not uncommon, consisting of stalactitic forms and concretions. The veins often contain a nucleus of native silver. It was formerly obtained in the Saxon mining districts of Johanngeorgenstadt and Freiberg, but is now rare. A mass, weighing six and three quarter pounds, from this locality, is now in the Zwinger collection, at Dresden. It also occurs in Siberia; at Kongsberg in Norway; in Cornwall, and at Huelgoet in Britanny: also at Andreasberg in the Hartz, an earthy variety is met with, called by the Germans, Buttermilcherz, which, according to Klaproth, contains Silver 24·64, muriatic acid 8·28, alumina 67·08.

Horn silver, when found in large quantities, is valuable as an ore of silver.

IODIC SILVER. CERATES FOLIACEUS.

Vauquelin, Ann de Ch et de Ph xxix, 99

Structure foliated.

Soft. *Lustre* resinous. *Streak* semi-metallic. *Color* white-yellowish-green. Translucent. Plates flexible.

According to experiments by Vauquelin, it contains silver, lead, iron, iodine, and sulphur.

Before the blowpipe on charcoal it fuses immediately, producing a vapor which tinges the flame of a fine violet color, and affording some globules of silver.

Obs. Iodic silver occurs in thin veins in steatite, at Albarradon, near Mazapil, in Mexico. It was first recognized by Vauquelin, among some specimens which M. Joseph Tabary brought from that country.

BROMIC SILVER. CERATES VIRIDIS.

Bromid of Silver, *Berthier*, (Ann de M iii 4th ser p 526 1842.) Plata verde *of the Mexicans*.

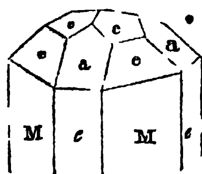
Primary form, the regular octahedron. Occurs in small concretions, and rarely in crystals; generally green without and bright yellow within.

Composition, according to Berthier, Silver 57.5, bromine 42.5.

Obs. Occurs with other silver ores in the district of Plateros, Mexico, at the mine of San Onofre, seventeen leagues from Zacatecas, associated with chlorid of silver and carbonate of lead; also at Chanarcillo, Chili, with chlorid of silver; also at Huelgoet in Brittanny, with horn silver.

HORN QUICKSILVER. CERATES QUADRATUS.

Pyramidal Pearl Kerate, *M*. Muriate of Mercury. Dichlorid of Mercury, *Thom*. Native Calomel. *Haid*. Chlorquecksilber. Quecksilb rhorners.



Primary form, a right square prism. *Secondary form*, M : c 135°, M : e=158°, M : e′ =129° 32′, e : a 120° 5′. *Cleavage* lateral, indistinct. Also in crystalline coats, and granular.

H. 1—2. G.=6.482, Haidinger. *Lustre* adamantine. *Streak* white. *Color* yellowish gray, or ash gray, also grayish and yellowish-white. Translucent—subtranslucent. *Fracture* conchoidal. Sectile.

Composition, according to Klaproth, Oxyd of mercury 76, muriatic acid 16.4, sulphuric acid 7.6. Artificial calomel is composed of mercury 85.12, and chlorine 14.88.

When pure, it is entirely volatilized before the blowpipe, on charcoal, and it is thus distinguished from the preceding species. It is insoluble in water.

Obs. This mineral is of even rarer occurrence than horn silver. Its principal locality is Moschellandsberg in Deuxponts, where it occurs coating the cavities of a ferruginous gangue associated with cinnabar. The crystals are often large and well defined. It has also been observed at the quicksilver mines of Idria in Carniola, at Almaden in Spain, and at Harzowitz in Bohemia.

IODIC MERCURY.

In particles of a reddish-brown color on selenid of mercury, in Mexico.—Del Rio.

ORDER IV. OSMERINEA.

HALLOYLITE. Hydrolus cerinus.

Halloysite, *Berthier*, Ann. de Ch. et de Ph. xxxii, 332, and Ann. des Mines, 3d ser. ix, 500. Tucsite, *Thom.*

Compact, and having the aspect of steatite.

Yields to the nail, and may be polished by it. G.=1·8—2·1. *Lustre* waxy. *Streak* white. *Color* white, generally with a bluish tint. Subtranslucent. *Fracture* conchoidal, like that of wax. Adheres to the tongue. When small pieces are put in water, they become transparent, like hydrophane; air is disengaged, and they increase in weight.

Composition, according to Berthier,

	Liege.	Bayonne.
Silica,	39·5	46·7
Alumina,	34·0	36·9
Water,	26·5=100	16·0=99·6

When calcined, it loses one fourth of its weight, and becomes milk-white. It is readily dissolved by sulphuric acid, which unites with the alumina, and leaves the silica in a gelatinous state.

Obs. Occurs with ores of zinc, iron, and lead, near Liege and Namur. Also at Housscha, near Bayonne. It was first described by Berthier, and named in compliment to its discoverer, M. Omalius d' Halloy. According to Brongniart, it results from the decomposition of a graphic granite.

The *Lenzinite* of John, from Kall in the Eifeld, in Prussia, the *Severite* of Dufour, from St. Sever in France, and the *Pholerite*, which appears in the form of soft nacreous scales of a white color, from the coal formation of Fins in the Dep of Allier, in France, are similar compounds with the above, and may be mere varieties. *Pholerite*, according to Guillemin, consists of Silica 41·65, alumina 43·35, water 15·00.

KOLLYRITE. Hydrolus argilliformis.

Alumine Hydraté Silicifère, *Levy*. Hydrous Trisilicate of Alumina, *Thom.*

Massive; resembling clay in its general appearance.

Light and friable; H. sometimes as high as 3. *Lustre* of the surface of fracture vitreous. *Color* snow-white. Translucent—opaque. Adheres to the tongue. Hardly soils the fingers. *Fracture* earthy.

Composition, according to Klaproth, (Beit i, 257,) and Berthier, (Ann des M., ii, 476,)

	Schemnitz	Esquerre
Silica,	14	15·0
Alumina,	45	44 5
Water,	42=101, K	40 5=100, B

Before the blowpipe it remains unaltered When calcined, it gives off much water, separates into columnar masses, like starch, and loses weight, it will then absorb water with a slight noise, and become partly transparent Dissolves without effervescence in nitric acid, forming a saline magma without crystals

OBS This species was discovered by M Lelièvre, on the mountain of Esquerre, in the French Pyrenees It was afterwards found in the shaft of Stephanus, in porphyry at Schemnitz in Hungary

SCARBROITE HYDROLUS ADHÆRENS.

Massive. G =1 48. Without *lustre*. *Color* pure white. *Fracture* conchoidal *Odor* argillaceous when breathed on. Highly adhesive to moist surfaces, admits of being polished by the nail. When immersed in water, it does not become translucent, neither does it fall to pieces, but it increases in weight.

Composition, according to Vernon, Alumina, 42 75, silica 7 90, water 48 55, peroxyd of iron 0 80=100

OBS. It occurs between laminæ of oxyd of iron, in a calcareous rock on the coast of Scarborough.

PYRARGILLITE HYDROLUS PYROSMICUS

Nordenskiold, Jahresbericht, 1833, p 174

Massive; occasionally presenting the form of a four-sided prism, with truncated angles or beveled edges, frequently traversed with minute chlorite particles *Color* partly black and shining, or bluish and dull. Emits an argillaceous odor.

Composition, according to Nordenskiold, Silica 43 93, alumina 28 93, oxyd of iron 5 30, magnesia with a little oxyd of manganese 2 9, potash 1 05, soda 1 85, water 15 47=99 43 It is entirely soluble in nitric acid

OBS Occurs in granite near Helsingfors in Finland It was named as above by Nordenskiold, on account of its argillaceous odor when heated, from πῦρ, *fire*, and ἄργιλλος, *clay*

ROSITE HYDROLUS ROSEUS

Rosellan, *Svanberg*, K Vet Ac Handl f 1840—Pogg liv, 268, and lvi, 170

In small grains, without crystallization. H.=2·5. G.=2·72—2·751. *Color* red,—faint rose-red to brownish-red; the former more common. Subtransparent. *Fracture* splintery, and in the larger grains somewhat foliated, with the surface of fracture, shining.

Composition, according to Svanberg,

Silica 44·901, alumina 34 506, peroxyd of iron 0 688, peroxyd of manganese 0 191, potash 6 628, soda *a trace*, lime 3 592, magnesia 2·448, water 6·533=99·476 The red color of the mineral is supposed by Svanberg to be due to the manganese.

Before the blowpipe in a matrass it gives off water and becomes colorless. In the forceps, thin splinters fuse, but do not form a globule Dissolves in borax with intumescence,

slowly in salt of phosphorus and readily in soda, the quantity of which flux may be increased without affecting the fusibility. With cobalt, affords a dark blue glass.

OBS. Rosite is disseminated in grains through a limestone in Södermanland, containing spinels. It is similar to amphodelite in composition, but differs in hardness and action before the blowpipe. The name alludes to its rose color.

Svanberg describes another mineral allied to Rosite, if not identical with it, from the granite of Tunaberg in Sudermanland, which has been considered amphodelite. He names it *Polyargite*. It occurs in larger grains than Rosite, or in foliated masses with a pearly lustre on the cleavage surface. Hardness=4. Colorless, red, and sometimes violet. Fracture, transparency, specific gravity, and action with acids and the blowpipe, same as Rosite. *Composition*,

Silica 44·128, alumina 35·115, peroxyd of iron 0·961, protoxyd of manganese *a trace*, potash 6·734, lime 5·547, magnesia 1·428, water 5·292=99·205.

ALLOPHANE. HYDROLUS TINCTUS.

Lamprochromatic Opaline-Allophane, *M.* Riemannite.

Reniform and massive; sometimes presenting traces of crystallization on the surface; occasionally almost pulverulent.

H.=3. G.=1·852—1·889. *Lustre* vitreous, or resinous; splendent and waxy internally. *Streak* white. *Color* pale-blue; sometimes green, brown, or yellow. Translucent. *Fracture* conchoidal and shining. Very brittle.

Composition, according to Stromeyer, (Gilbert's Annalen, liv, 120,) Walchner, (Schweig. J. xlix, 154,) and Berthier, (Ann. des Mines, 1836, ix, 499,)

						Transparent variety.	Pulverulent variety
Alumina,	32·202		38·76			29·2	34·2
Silica,	21·922		24·11			21·9	26·3
Water,	41·301		35·75			44·2	38·0
Carb. of copper,	3·058	Ox. copper,	2·33	Mixed clay,		4·7	1·5
Lime,	0·730		——			——	——
Sulph. of lime,	0·517		——			——	——
Hyd. perox. iron,	0·270=100, S.		——=100·95, W.			——=100, B.	——=100, B.

The heat of the blowpipe speedily deprives it of its color, and renders it opaque and pulverulent, producing at the same time some intumescence, and tinging the flame green. It does not fuse *per se*, but with borax melts readily to a transparent and nearly colorless glass. Forms a jelly with acids.

OBS. Allophane occurs lining irregular cavities in a kind of marl, at Saalfeld in Thuringia, at Schneeberg in Saxony, and elsewhere. The specimens analyzed by Berthier, occur abundantly in the chalk of Beauvais, France; they present a honey-yellow color. It was first observed by Messrs. Riemann and Roepert, and hence has been called *Riemannite*. The first analysis and description were made by Hoffman and Stromeyer, in 1816. The name allophane is derived from ἄλλος, *other*, and φαίνω, *to appear*; in allusion to its change of appearance under the blowpipe.

CIMOLITE.

Massive, earthy.

Very soft. G.=2·18—2·00. Lustre of streak greasy. *Color* white, grayish.

Composition, according to Klaproth, Silica 63, alumina 23, peroxyd of iron 1·25, water 12=99·25. Infusible. Not acted on by the acids. It is a doubtful species.

OBS. Occurs at Cimolis on the island Argentiera, in the Grecian Archipelago.

NONTRONITE.

Ann. de Ch. xxxvi, *Berthier*.

Structure like clay. *Color* pale-straw or canary-yellow, greenish.

Opaque. *Feel* unctuous; tender. Affords an odor when breathed on. Flattens and grows lumpy under the pestle. Polished by friction.

Composition, according to Berthier, Silica 44, peroxyd of iron 29, alumina 3·6, magnesia 2·1, water 18·7, clay 1·2. Immersed in water, it disengages air, becomes subtranslucent, and increases in weight. Slightly heated, it loses its water, and assumes the color of red oxyd of iron. It is readily acted on by muriatic acid, and, in part, is gelatinized. Calcined, it becomes sensibly magnetic.

Obs. Occurs in reniform masses, seldom larger than the fist, among the manganese, in Nontron, department of Dordogne, in France.

Pinguite of Leonhard. Massive. *Lustre* slightly resinous. *Streak* lighter than the color. *Color* siskin and oil-green. Does not adhere to the tongue, and emits a feeble argillaceous odor when struck. Extremely soft, resembling new made soap.

It contains, according to Kersten, Silica 36·9, oxyd of iron 35·6, alumina 1·8, magnesia 0·45, oxyd of manganese 0·14, water 25·10, (Schweig. J. lxvi, 9.)

GIBBSITE. Hydrargillus Gibbsianus.

Torrey, New York Med. and Phys. J. No. i. p. 68.

Stalactitic or small mammillary. Structure, more or less distinctly fibrous, the fibres radiating from a central line.

H.=3—3·5. G.=2·091, Thomson; 2·4, Torrey; 2·305, Beck. *Lustre* faint. *Streak* white. *Color* grayish, or greenish-white. Translucent.

Composition, according to Dr. Torrey, (New York Med. and Phys. Journ. i, 68,) Alumina 64·8, water 34·7. Dr. Thomson gives the following composition as the result of his analysis, which may have been obtained from a less pure specimen: Alumina 54·91, water 33·60, silica 8·73, peroxyd of iron 3·93=101·17.

Obs. It has been found in small quantities in a bed of brown iron ore at Richmond, Mass., where it was first discovered by Dr. Emmons; also at Lenox, Mass., at the clove mine in Union Vale, Duchess Co., N. Y., on hematite, and in Orange Co., N. Y. On one specimen of Gibbsite, Prof. Hitchcock has observed tufts of delicate needles, which he believes to be crystals of Gibbsite. (Rep. Geol. Mass. p. 585.)

This species was named in honor of Col. George Gibbs.

Hydrargillite. The Hydrargillite of Rose (Pogg. xlviii, 564, 1839) is allied to this species. From trials by Rose, it is supposed to be a hydrate of alumina with a mere trace of lime. The following are its characters:—*Primary form*, a hexagonal prism; *secondary*, the prism with the lateral edges replaced. M, vertically striated; P, smooth. *Cleavage*, parallel with P, perfect. H.=2·5—3. *Lustre* of P, pearly; of the lateral planes, weak vitreous. *Color*, faint reddish-white. Translucent; in thin splinters transparent.

Affords a fine blue color with cobalt. Alone before the blowpipe it whitens, but is infusible. Yields water when heated in a glass tube.

Hydrargillite was discovered by Lissensko, in the Schischimskian Mountains, near Slatoust. The specimen examined by Rose consisted mostly of magnetic iron, through which the hydrargillite was disseminated. The larger crystals were from 1 to 2 lines

PINITE. Stylus hexagonus.

Rhombohedral Serpentine-Steatite, *M.* Pinite, *Werner.* Micarelle, *Kirwan.*

Primary form, a hexagonal prism. *Secondary form*, the primary with its lateral edges truncated or beveled; often the bevel-

ment is so far extended as to produce twelve-sided prisms. *Cleavage* indistinct.

H.=2·25. G.=2·7575, C. G. Gmelin, a variety from St. Pardoux; 2·782, Haidinger, crystallized specimen from France. *Lustre* resinous, inclining to pearly; glistening. *Streak* white. *Color* gray, grayish-green, or brown. Opaque. *Fracture* uneven.

Composition, according to Gmelin, (Jahresb. v, 218,)

	St. Pardoux.
Silica,	55·964
Alumina,	25·480
Potash,	7.894
Soda,	0·386
Peroxyd of iron,	5·512
Magnesia, with manganese,	3·760
Water,	1·410=100·406

Before the blowpipe it whitens and fuses on the edges, but does not melt. With borax, after a continued blast, it yields a transparent globule, colored by iron.

A variety from Saxony is entirely unalterable before the blowpipe. It also differs in composition, containing, according to Klaproth, Silica 29·5, alumina 63·75, and oxyd of iron 6·75. No distinction has been noticed, however, in their forms.

Obs. This species was distinguished by Werner, and named from the Pini gallery in the Schneeberg mines, where it was first discovered.

It occurs imbedded in decomposed feldspar-porphyry, at the Puy-de-Dome in Auvergne; in granite, at Schneeberg in Saxony; at Linsenz in the Tyrol; and in primitive rocks in Cornwall and Aberdeenshire. The Pinite of Lancaster, Mass., may prove on analysis to be one of the three species following Killinite.

KILLINITE.

Peritomous Picrosmine-Steatite, *M.*

Occurs in irregular thin crystals, apparently rectangular prisms; also in crystalline masses.

H.=4. G.=2·65—2·75. *Lustre* vitreous, weak. *Streak* yellowish-white. *Color* greenish-gray, often tinged brown by oxyd of iron, or from decomposition. Faintly translucent.

Composition, according to Barker, Lehunt, and Blythe,

Silica,	52·49	49·08	47·925
Alumina,	24·50	30·60	31·041
Potash,	5·00	6·72	6·063
Water,	5·00	10·00	10·000
Protox. iron,	2·49	2·27	2·328
Lime,	——	0·68	0·724
Magnesia, with mang.	——	1·08	0·459
Protox. manganese,	0·75=90·24, B.	——=100·43, L.	1·255=99·795, Bl.

FAHLUNITE. Stylus acrotomus.

Triclasite, *H.* Tricklasite, *P.* Fahlunite, *Hisinger.*

Occurs in six-sided prisms. *Cleavage*, basal, perfect.

H.=3. G.=2·6—2·79. *Lustre* resinous or vitreous. *Streak* grayish-white. *Color* green, passing into dark-brown and black. Opaque.

Composition, according to Hisinger and Wachtmeister, (K. V. Ac. H. 1827, p. 21,)

		Crystals; Terra Nova.
Silica,	46·79	44·60
Alumina,	29·73	30·10
Magnesia,	2·97	6·75
Protoxyd of iron,	5·01	3·86
Oxyd of manganese,	0·43	2·24
Water,	13·50=101·43, H.	9·35=96·90, W.

Wachtmeister detected also 1·35 of lime and 1·98 of potash and soda, with a trace of fluoric acid.

Before the blowpipe it becomes gray, and the thinnest edges fuse. It dissolves slowly with borax, yielding a glass slightly covered with iron.

Obs. It occurs in the mine of Eric Matts, near Fahlun, in Sweden, where it is found both massive and crystallized, imbedded in chlorite slate, and associated with copper pyrites, galena, and dichroite. The crystals, from their highly perfect cleavage, almost invariably break in parallel position with the slate, and thus present only sections of their form.

The *Hydrous iolite* of Bonsdorff approaches Fahlunite in composition. It occurs in modified six-sided prisms of a greenish-brown or dark olive-green color, foliated parallel with the base; H.=3·75: it consists of Silica 45·05, alumina 30·05, magnesia 9·00, protoxyd of iron 5·30, water 10·60=100. It occurs with iolite at Abo.

CHLOROPHYLLITE. Stylus foliaceus.

Esmarkite, *Erdmann*, Jahresb. 1841, p. 174. Chlorophyllite, *Jackson*, 1st An. Geol. Rep. of N. Hampshire, p. 152. Pinite.

Occurs in six and twelve-sided prisms. Highly foliated parallel to the base of the prism; sometimes also a prismatic cleavage more or less distinct.

H. of basal plane 1·5—2; the lateral edges will scratch apatite. G.=2·705, Jackson; 2·709, Erdmann. *Lustre* of basal plane, pearly; of lateral, pearly or greasy to imperfectly vitreous. *Color* green or greenish, greenish-brown—dark olive-green. Translucent to subtranslucent. Folia neither flexible nor elastic; brittle.

Composition, according to Jackson, (communicated to the author,) and Erdmann, (Jahresb. 1841, 174,)

	Chlorophyllite.	*Esmarkite*, Brevig.
Silica,	45·20	45·97
Alumina,	27·60	32·08
Magnesia,	9·60	10·32
Protoxyd of iron,	8·24	3·83
Protoxyd of manganese,	4·08	0·41
Water,	3·60=98·32, J.	5·49=98·10, E.

Traces of phosphoric acid were detected in the chlorophyllite.

This mineral is closely allied to the hydrous iolite of Bonsdorff, but contains less water. Like that, it is found associated with iolite. Yields water before the blowpipe, and becomes bluish-gray, but fuses only on the edges. With carbonate of soda, effervescence takes place, and an opaque greenish enamel is formed, which becomes darker green in the reducing flame.

Obs. Chlorophyllite is usually associated with iolite in granite, and appears to proceed from the alteration of iolite. It often forms thin folia interlaminated with plates of iolite in the hexagonal prisms of this mineral, and sometimes appears to graduate into iolite.

The chlorophyllite of Jackson occurs abundantly in large prismatic and tabular crystals at Neal's mine in Unity, Maine, associated with hornblende rocks containing iron and copper pyrites. The same mineral occurs with iolite at Haddam, Connecticut, and has been called Pinite. The Esmarkite of Erdmann is found in granite near Brevig in Norway.

The name Chlorophyllite, given this species by Dr. Jackson, is derived from χλωρος, *green*, and φυλλον, *leaf*, and alludes to its structure and color. The name Esmarkite was previously appropriated to a variety of Datholite.

It is probable that both the hydrous iolite of Bonsdorff and chlorophyllite have proceeded from the alteration of iolite, and the hexagonal forms the crystals present may have been derived from the original iolite, instead of being the actual crystallization of the hydrous mineral. Gigantolite, Pinite, and Fahlunite, may also be altered forms of other minerals, and probably of iolite.

GIGANTOLITE.

Gigantolite, *Nordenskiöld*; *Trolle-Wachtmeister*, Pogg. xlv, 558.—Jahresb. xix, 295.

Primary form, a hexagonal prism. *Secondary*, a twelve-sided prism. *Cleavage* parallel with the base and sides of the primary; that with the base perfect and showing a thin foliaceous structure.

H. about 3·5; of the basal surface=2. G.=2·862—2·878. *Lustre* between vitreous and waxy, and approaching submetallic. *Color* greenish to dark steel-gray.

Composition, according to Wachtmeister,

Silica 46·27, alumina 25·10, peroxyd of iron 15·60, magnesia 3·80, protoxyd of manganese 0·89, potash 2·70, soda 1·20, fluorine *a trace*, water with ammonia 6·00=101·56.

Fuses readily before the blowpipe, with some intumescence, to a shining light-greenish slag, which does not form a globule. With borax and salt of phosphorus, melts slowly and with difficulty to a clear glass.

Obs. Gigantolite was found at Tamela in Finland, in a micaceous gneissoid granite. The name alludes to the large groups of crystals. It is allied to Fahlunite and also to chlorophyllite, but is less distinctly foliated than the latter.

AGALMATOLITE.

Uncleavable Glyphine-Steatite, *M.* Figure Stone. Bildstein. *W.* and *L.* Koreite. Lardite. Pagodite. Talc Graphique, *H.*

Massive; structure sometimes slaty.

H.=2; yields to the nail. G.=2·815, Klaproth; 2·895, Thomson. *Lustre* waxy, nearly dull. *Streak* white or grayish-white, somewhat shining. *Color* white, greenish, grayish, yellowish, brownish; rarely also pink and mottled. Subtranslucent—nearly opaque. *Fracture* coarse splintery. Sectile. *Feel* greasy.

Composition, according to Vauquelin, (Ann. de Ch. xlix, 83,) Klaproth, (Beit. v, 19,) John, (Ann. of Phil. iv, 214,) and Thomson, (Min. i, 343,)

Silica,	56	55	55	51·5	49·816
Alumina,	29	33	30	32·5	29·596
Lime,	2	—	1·75	3·9	6·000
Protox. iron,	1	0·5	1	1·75	1·500
Protox. mang.	—	—	trace.	1·2	——
Potash,	7	7	6·25	6·0	6·800
Water,	5, V.	3, K.	5·5, J.	5·13, J.	5·5, T.

The specimens analyzed by the above chemists were from China. Klaproth obtained very nearly the same result with a specimen from Nagyag.

Holger (Zeitsch. für Phys. 1837, s. 1) found the silica and alumina in the proportion of 61 to 25.

Wackenroder has analyzed a figure stone from China, (Erdmann's Journ. xxii, 8,) and found it to be magnesian, (silicate of magnesia with 3 per cent. of water,) and allied to compact talc.

The Chinese appear to use both a magnesian and aluminous stone for their carvings, and neither are probably unmixed chemical compounds.

Before the blowpipe it whitens, but is infusible. With borax, it affords a colorless glass. It dissolves in part in sulphuric acid, leaving a siliceous residue.

OBS. Agalmatolite occurs principally in China, where it is carved into grotesque images or pagodas, and chimney-piece ornaments. It is found also at Nagyag in Transylvania; in Norway and Wales, in less characteristic varieties.

PYRALLOLITE. OPHITIS TRICLINATUS.

Tetarto-prismatic Picrosmine-Steatite, *M.* Pyrallolite, *Nordenskiöld.* Tersilicate of Magnesia, *Thom.*

Primary form, an oblique rhomboidal prism; P ; M=140° 49′, T=94° 36′. *Secondary form,* the primary with the obtuse lateral edges replaced. *Cleavage* distinct parallel to M and T; also in the direction of *e*. Usually granular massive.

H.=3·5—4. G.=2·555—2·594. *Lustre* dull, sometimes slightly resinous. *Streak* white. *Color* white, sometimes greenish. Subtranslucent—opaque. *Fracture* earthy.

Composition, according to Nordenskiöld, (Schweig. J. xxxi, 386,)

Silica,	56·62
Magnesia,	23·38
Alumina,	3·38
Lime,	5·58
Protoxyd of mang.	0·99
Perox. of iron,	0·09
Water,	3·58
Bitumen and loss,	6·38=100

Before the blowpipe, it becomes first black, then white again; afterwards it intumesces, and melts on the edges to a white enamel. With borax, it yields a transparent glass. With soda, it fuses easily to a yellowish-green transparent glass. With biphosphate of soda, there is a slight effervescence, but fusion is obtained with great difficulty.

OBS. The only known locality of pyrallolite is at Storgord in the parish of Pargas, in Finland, where it occurs in a limestone bed, with feldspar, pyroxene, scapolite, moroxite, and sphene. It was discovered by Count Steinheil, and first described and analyzed by Nordenskiöld. Its name is from the Greek πυρ, *fire,* αλλος, *other,* λιθος, *stone,* in allusion to the change of color it experiences before the blowpipe.

HYDROUS SILICATE OF MAGNESIA.

There are several compounds which may come under the above general name, whose titles to the rank of species are not fully determined. They are as follow:

Sea Foam, called also *Meerschaum,* and *Magnesite.* The specimen from Coulommiers, thirty miles east of Paris, analyzed by Berthier, was soft, impressible by the nail; had a smooth and unctuous feel, and a grayish-white, and occasionally slightly reddish color; when immersed in water, it imbibed it readily, and increased in bulk, and finally formed a soft paste, without plasticity, similar to jelly. *Composition,* Silica 54, magnesia 24, water 20·1, alumina 1·4. When heated, it loses its grayish or reddish tint, and becomes white.

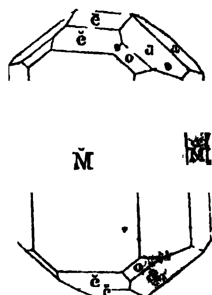
Meerschaum of Thomson. It occurs at Eski Schehcr in Natolia, in a large fissure six feet wide in calcareous earth. H.=2. *Lustre* dull. *Color* white. Opaque. *Fracture* fine, earthy. Surface smooth. *Composition,* Silica 42, magnesia 30·5, water 23, lime 2·3, alumina with a trace of manganese 2=99·8. Heated, it gives out water and a fetid odor, becomes hard and perfectly white. It is employed for the manufacture of the bowls of Turkey tobacco pipes, and thus supports a monastery of Dervises, established near where it is dug. The workmen assert that it grows again in the fissure, and puffs itself up like froth.

Quincite, of Berthier, is disseminated through a limestone deposit, extending from Mehun in France, beyond the village of Quincey. It is in light particles, of a carmine-red color; this color is removed by heat, which at the same time evolves water. *Composition*, Silica 54, magnesia 19, protoxyd of iron 8, water 17=98. Strong concentrated acids dissolve the magnesia and iron, and leave the silica in a gelatinous state.

Aphrodite, of Berlin, (K V. Ac. H 1840.) Soft and earthy like meerschaum *Composition*, according to Berlin, Silica 51 55, magnesia 33 72, protoxyd of manganese 1 62, protoxyd of iron 0 59, alumina 0 20, water 12 32 This is the meerschaum of Longbanshyttan The name is derived from *αφρος, foam*

SERPENTINE. OPHITIS COMMUNIS.

Prismatic Serpentine-Steatite, *M* Hydrous Sesquisilicate of Magnesia, *Thom* Marmolite of *Nuttall*, Silliman's Jour iv, 18 Deweylite, *Emmons* Οφιτης, Ophitis, *Vetruvius* Talcum Serpentinum, *Linn*, *Wern* Picrolite, *Hausmann* Baltimorite, Gymnite, *Thom* Kypholite, *Breit*



Primary form, a right rectangular prism. *Secondary form*, M̆ : e′=131° 14½′, e′ : e′= 82° 27′, M̆ : ē=115° 44′, M̆ : e′=133° 58′, a : a =105° 26′. The forms, figs. 70, 74, and 80, Plate II, have been observed at Rossie, N. Y., (Beck.) *Cleavage* indistinct parallel to M̆ and e′, apparent only in a strong light. Usually massive; also fibrous and foliated.

H.=3—4. G.=2·507; 2·591, Thomson. *Lustre* resinous—greasy, low degrees of intensity. *Streak* white, slightly shining. *Color* leek-green and blackish-green; occasionally, oil and siskin-green; none bright. On exposure, it often becomes yellowish gray Translucent—opaque. *Fracture* conchoidal or splintery. Sectile.

sembling some forms of asbestus *Marmolite* is a foliated variety, often of light shades of green, and sometimes greenish- or bluish-white, consisting of thin brittle laminæ, often easily separable The *Kypholite* of Breithaupt is probably a variety of marmolite or foliated serpentine

Much of the so-called *Kerolite* of this country, if not all, is a foliated serpentine, as stated by Beck, differing from marmolite only in its greater compactness, the laminæ being not separable. The Westchester and Richmond Co. varieties analyzed by Beck, are of this kind; a specimen from Zoblitz, (given under Kerolite, as one of it foreign localities,) analyzed in Rammelsberg's laboratory, proved to be nearly identical in composition with the serpentine in which it was found.

Composition, according to Lychnell, (K V Ac. H. 1826, p 175,) Hisinger, (Afhand iv, 341,) Mosander, (K. V Ac. H. 1825, p 227,) Stromeyer, (Untersuch 365,) Vanuxem, (J. Ac. Sci. Phil. iii,) Shepard, Beck, (Min N Y., p. 280,) and Jackson, (Sill. J. xxxviii, 198,)

	Yellow, Sjögruvan.	*Precious*, Fahlun	Fahlun.	*Colorless*, Wermland	*Picrolite*, Wermland.
Silica,	41 58	41·95	43 07	42 34	41 660
Magnesia,	42 41	40 64	40·37	44 20	37·159
Lime,	——	——	0·50	——	——
Alumina,	trace	0 37	0·25	——	——
Protoxyd of iron,	[illegible]·17	2·22	1·17	0·18	4 046
Carbonic acid,	2·38	3·42	——	0 87	——
Ox. mang.	——	——	——	——	2 247
Water,	11·29	11·68	12·45	12·38	14 723
	99 83, L.	100 28, L.	97 81, H	99 97, M	99 835,

	Marmolite; [illegible]	Marmolite; Bare Hills.	Richm. Co., N. Y.	Lamellar.; Westch. Co., N. Y.	Serpentine Marble; Vermont.
Silica,	[illegible]	42·69	41·00	40·50	45·80
Magnesia,	[illegible]	40·00	41·26	38·00	33·44
Alumina,	——	——	trace	——	Mag. iron, 2·00
Lime,	——	Carb. ac. 0·87	2·39	——	Ox. chrome, 2·00
Protox. of iron,	2·70	1·16	Perox. 1·85	trace	7·60
Water,	15·67	16·11	13·50	21·00	7·70
	99·85, Shep.	99·96, V.	100·00, B.	99·50, B.	98·54, J.

Serpentine gives off water and becomes brownish-red before the blowpipe, but fuses only on the edges. The serpentine marble analyzed by Jackson has a hardness equal to feldspar. It is a rock, and not a simple mineral.

Thomson's *Baltimorite* (Phil. Mag. xxii, 191, 1843) is identical with picrolite. *Gymnite* (Phil. Mag. xxii, 191) is an impure serpentine from the Bare Hills, Md. The *meerschaum* of Taberg and Sala, Sweden, is a soft earthy serpentine resembling meerschaum in external appearance. (*Berlin*, K. V. Ac. H. 1840.) The *Schillerruder asbest*, (Schiller asbestus,) a fibrous mineral from Reichenstein, consists, according to Kobell, of Silica 43·50, magnesia 40·00, protoxyd of iron 2·08, water 13·80, alumina 0·40=99·78, and is allied to serpentine.

Obs. Serpentine often constitutes mountain masses, mostly in primary regions. Mixed with carbonate of lime, it forms *verd antique marble*, which occurs often in extensive beds. Chromate of iron is often disseminated through serpentine, giving it a mottled appearance, somewhat similar to the skin of a snake, whence the name, *serpentine* or *ophite*.

Dark-green opaque crystals of serpentine occur in the Fassa valley, Tyrol. They have been considered pseudomorphs; and M. A. Quenstedt has suggested probable reasons for believing them pseudo-crystals of chrysolite, (see § 45.) The finest precious serpentines come from Fahlun and Gulsjo in Sweden, the Isle of Man, the neighborhood of Portsoy in Aberdeenshire, Corsica, Siberia, and Saxony. Common serpentine occurs at Lizard's Point in Cornwall, and many other places.

In the United States, precious serpentine, of a light-green color, occurs at Phillipstown in the Highlands, N. Y.: also at Port Henry, Essex Co.; at Antwerp, Jefferson Co., in crystals; at Syracuse, east of Major Burnet's, interesting varieties; in Gouverneur, St. Lawrence Co., in crystals, and also in Rossie, two miles north of Somerville; at Johnsburg in Warren Co.; Davenport's Neck, Westchester Co., affording fine cabinet specimens; in Cornwall, Monroe, and Warwick, Orange Co., sometimes in large crystals at Warwick; and from Richmond to New Brighton, Richmond County. In Massachusetts, fine at Newburyport; at Blandford with Schiller spar, and the marmolite variety; also at Westfield, Middlefield, Lynnfield, Newburyport, and elsewhere. In Maine, at Deer Isle. In Vermont, at New Fane, &c. In Rhode Island, at Newport. In Connecticut, near New Haven, at the verd antique quarries. In New Jersey, at Hoboken, with Brucite, magnesite, &c., and the marmolite variety; also at Frankfort and Bryan. In Maryland, at Cooptown, Harford Co., with Diallage; also in the north part of Cecil Co. In Pennsylvania at Chesnut Hill.

Serpentine admits of a high polish, and may be turned in a lathe, and is sometimes employed as a material for ornaments, vases, boxes, &c. At Zöblitz in Saxony, Bayreuth, and in Franconia, several hundred persons are employed in this manufacture. Verd antique marble is clouded with green of various shades, and is a beautiful material for tables and ornamental in-door work. Exposed to the weather, it wears uneven, owing to its unequal hardness, and soon loses its polished surface.

As serpentine rock is often an intimate mixture of serpentine with other minerals, there is scarcely a limit to the number of species which analysis, if alone the test, would afford. The following have been proposed as species; but as they occur only massive, or imperfectly crystallized, it is doubtful whether they are definite chemical compounds or not.

Dermatin—Breithaupt. Massive, reniform or in crusts on serpentine, of a resinous lustre and green color. Feel greasy; odor, when moistened, argillaceous. *Composition*, according to Ficinus, Silica 35·800, magnesia 23·700, protoxyd of iron 11·333, protoxyd of manganese 2·250, alumina 0·416, lime 0·833, soda 0·500, water with some carbonic acid 25·200=100·032. From Waldheim in Saxony.

Retinalite—Thomson. Massive, with a greasy lustre. Translucent. Yellowish-brown. H.=3·75. G.=2·49. *Composition*, Silica 40·550, magnesia 18·856, soda 18·832, alumina 0·300, peroxyd of iron 0·620, water 20·000=99·158. From Granville, U. C.

Hydrophite—Svanberg, (K. V. Ac. H. 1839, and Pogg. li, 537.) Occurs massive, rarely fibrous. H.=3·5. G.=2·65. Mountain-green. *Composition*, Silica 36·193; protoxyd of iron 22·729, protoxyd of manganese 1·660, magnesia 21·082; alumina 2·895, vanadic acid 0·115, water 16·080=100·754. Occurs with picrolite at Taberg in Smoland.

Picrophyll—Svanberg. Amorphous and foliated, of a deep greenish-gray color. G.=2·75. *Composition*, Silica 49·80, magnesia 30·10, protoxyd of iron 6·86, lime 0·78, alumina 1·11, water 9·83=98·48, (Pogg. l, 662.)

KEROLITE. Ophitis foliaceus.

Hydrosilicit, Wachstein.

In kidney-shaped or reniform masses: structure lamellar or compact.

H.=2—2·25. G.=2—2·2. *Lustre* vitreous, or resinous. *Streak* white. *Color* white, green. Transparent—translucent. *Fracture* conchoidal. *Feel* greasy; does not adhere to the tongue.

Composition, according to Pfaff,

Silica,	37·95
Alumina,	12·18
Magnesia,	16·02
Water,	31·00=97·15

Kerolite occurs at Frankenstein in Silesia, and at Zöblitz in Saxony, associated at each locality with serpentine. In the United States it is met with at Stony Point in Rockland Co., New York, and at Hoboken, New Jersey, along with Brucite, marmolite, and magnesite, in serpentine.

VILLARSITE.

Dufrénoy, Compt. Rend. xiv, 698.

Primary form, a rhombic prism; M : M=119° 59′.

Crystallizes in rhombic octahedrons with truncated apices; P : e =136° 52′, e : e (over terminal edge)=139° 45′, e : e (over basal edge)=86° 40′.

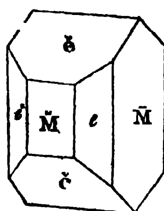
H.=3—3·5. G.=2·975. *Color* yellowish-green, somewhat resembling the apatite of Arendal. Subtransparent. *Fracture* granular.

Composition, according to Dufrénoy, (Ann. des M. 4th ser. i, 387,) Silica 39·61, magnesia 47·37, protoxyd of iron 3·59, prot. manganese 2·42, lime 0·53, potash 0·46, water 5·80=99·78. Infusible before the blowpipe. Forms a green enamel with borax. Soluble in strong acids.

Obs. Occurs at Traversella in Piedmont, in dolomite, with mica, quartz, and dodecahedral magnetic iron.

PICROSMINE. NEMATUS RECTANGULUS.

Picrosmine, *Haid.* Prismatic Picrosmine-Steatite, *M.* Dihydrous Bisilicate of Magnesia, *Thomson.*



Primary form, a right rectangular prism. *Secondary form:* M̆ : é=153° 26′, é : é=126° 52′, M̆ : ĕ=121° 6′, ĕ : ĕ (over M)=62° 11′. *Cleavage* parallel to M̄ perfect, to M̆ less so. *Imperfect crystallizations:* fine columnar or granular.

H.=2.5—3. G.=2·596—2·66. *Lustre* of M̄ pearly; of other planes, inclining to vitreous. *Streak* white and dull. *Color* generally greenish-white, sometimes dark green. Subtranslucent—opaque. *Fracture* uneven, scarcely perceptible; of imperfectly crystalline varieties, splintery.

Composition, according to Magnus, (Pogg. vi, 53,)

Silica,	54.88
Magnesia,	33.35
Alumina,	0.79
Peroxyd of iron,	1.39
Protoxyd of manganese,	0.42
Water,	7.30=98.13

Infusible alone before the blowpipe, but gives out water, becomes first black, then white and opaque, and acquires a hardness equal to 5. It is soluble in salt of phosphorus, with the exception of a skeleton of silica. Heated with nitrate of cobalt, it assumes a pale red color.

OBS. Picrosmine has been found only at the iron mine of Engelsburg, near Presnitz in Bohemia, where it is associated with magnetic iron ore. It resembles common asbestus in external appearance, but was distinguished from that mineral by Haidinger, who named it Picrosmine, from πικρος, *bitter*, and ὀσμὴ, *odor*, in allusion to the bitter and argillaceous odor of the moistened mineral.

HYDROUS ANTHOPHYLLITE. NEMATUS RADIATUS.

In slender plates or imperfect crystals diverging from various centres: the fibres separable.

H.=2.5. G.=2·91. *Lustre* silky. *Color* white, greenish-yellow, or bluish-gray. Opaque. Sectile, and has a soft feel.

Composition, according to Thomson,

Silica 54.98, magnesia 13.38, peroxyd of iron 9.83, protoxyd of manganese 1.20, potash 6.80, alumina 1.56, water 11.45. Infusible before the blowpipe.

OBS. Hydrous anthophyllite occurs in a talcose rock at Fishkill, N. Y., about five miles southeast of Stormville, on the land of Mr. Peck; also at New York between the 10th Avenue and the Hudson, and between 57th street and 63d street; the fibres are sometimes long and parallel, and at others short and radiated or interlaced, (Beck.) This species was instituted by Dr. Thomson.

NEMALITE NEMATUS GRACILIS

Nuttall, Silliman's Jour. iv, 19 Amianthoid Magnesite Silicious Hydrate of Magnesia, *Thomson*, Roy. Soc Trans Ed xi, 468.

Fibrous; fibres slender, elastic, sometimes curved, easily separable.

H.=2. G.=2·353, Thomson; 2·44, Nuttall. *Lustre* silky, or pearly. Some decomposed varieties have an earthy appearance. *Streak* white. *Color* grayish or bluish-white, sometimes slightly yellowish.

Composition, according to Thomson,

Magnesia,	51 721
Silica,	12 568
Peroxyd of iron,	5 874
Water,	29 666=99 829

In the flame of a lamp the fibres become opaque and rigid, and assume a light brown tinge In this state the mineral is easily reducible to a powder When rubbed with a piece of iron, the mineral phosphoresces with a yellowish light.

OBS Nemalite forms veins in the serpentine rocks at Hoboken in New Jersey, and in greenstone at Piermont, Rockland Co, N Y, and Bergen Hill, New Jersey The name is derived from νημα, a *thread*, in allusion to its fibrous structure

SCHILLER SPAR PHILLINIUS SCHILLERI

Diatomous Schiller Spar *M* Hydrous Bisilicate of Magnesia, *Thom* Karstin Schillerstein, *W* Talkartiger Diallag, *Haus* Spath-Chatoyant, Diallage Metalloide, (in part) *H*

Primary form, an oblique rhomboidal prism; M : T=between 135° and 145°. *Cleavage* in two directions; in one highly perfect and easy in the other, only in traces. Usually in broad separable laminæ, disseminated in serpentine.

H.=3·5—4. G.=2 5—2·652, Kohler. *Lustre* metallic-pearly on cleavage faces, indistinctly vitreous on the other faces. *Streak* grayish-white, inclining a little to yellow. *Color* olive and blackish-green, inclining to pinchbeck-brown upon the face of perfect cleavage. Subtranslucent. *Fracture* uneven, splintery. Sectile.

Composition, according to Drapier, (Jour de Ph lxii, 48,) and Kohler, (Pog. ii, 192,)

Silica,	41	43 900
Magnesia,	29	25 856
Oxyd of iron and chromium,	14	13 021
Water,	10	12 426
Alumina,	3	1 280
Lime,	1,	2 642
Protox Manganese,	—=98, Drapier	0 535=99 66, Kohler

Before the blowpipe, in the platinum forceps, it gives off water and becomes of a pinchbeck-brown color; the lustre is rendered still more metallic, and thin pieces become attractable by the magnet The thinnest edges only fuse before the blowpipe alone. With borax, it fuses with difficulty to a bead, which, on cooling, has a slight emerald green tinge, in consequence of the presence of chromium. The same phenomena are exhibited with biphosphate of soda, and besides, a skeleton of silica is left. With carbonate of soda, it does not fuse, but on platinum foil indicates the presence of manganese

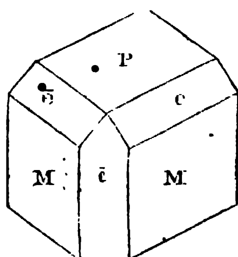
OBS. Schiller spar occurs at Baste, in the forest of Harzeburg in the Hartz, mixed with massive serpentine At Blandford, Mass, a blackish-green variety is met with, asso-

ciated with serpentine and marmolite; also near Westfield, and Russel, Mass., at Putnam and Amity, N. Y., and at Cooptown, Md.

Antigorite of Schweizer, (Pogg. xlix, 595.) This mineral is allied in composition and other characters to Schiller spar. It occurs in foliated masses, and the laminæ separate easily. H.=2·5. G.=2·622. Color brownish and leek-green. Thin laminæ transparent. Feel smooth but not greasy. Composition, according to Schweizer, (Pogg. xlix, 597,) Silica 46·22, protoxyd of iron 13·05, alumina 2·08, magnesia 34·39, water 3·70=99·44. Thin splinters fuse on the edges. With borax forms easily a glass colored with iron. Antigorite comes from Antigoris-Thala in Piedmont, whence the name.

CLINTONITE. PHYLLINIUS CLINTONI.

Seybertite, *Clemson*, Sill. Jour. xxiv, 171. Holmesite, *Thomson*.



Primary form, an oblique rhombic prism; M : M about 94°. *Secondary form*, the annexed figure by Horton. Structure foliated like mica, but less distinctly, and laminæ scarcely flexible when very thin.

H.=4—5. G.=3·098. *Lustre* metallic and metallic-pearly. *Color* reddish-brown, yellowish-brown, copper-red. *Streak* yellowish-gray.

Composition, according to Clemson, (Sill. J. xxiv, 171,) Richardson, and Plattner,

Silica,	17·0	19·35	26·4
Alumina,	37·6	44·75	46·7
Magnesia,	24·3	9·05	9·8
Lime,	10·7	11·45	12·5
Protoxyd of iron,	05·0	Perox. 4·80	4·3
Oxyd of manganese,	——	1·35	——
Zirconia,	——	2·05	——
Water,	3·6	4·55	3·5
Fluoric acid,	——=98·2, C.	0·90=98·25, R.	——=98·2, P

Infusible *per se* before the blowpipe. With carbonate of soda, or borax, a transparent pearl is obtained. In powder, it is acted upon by the nitric, muriatic, and sulphuric acids.

OBS. It occurs at Amity, Orange Co., N. Y., in limestone beds connected with serpentine, and associated with hornblende, spinel pyroxene, and plumbago. This species has been supposed to be a variety of bronzite, but the above analyses, though disagreeing, prove it to be a distinct species.

The *Xanthophyllite* of Rose is considered by him as closely allied to, or identical with, Clintonite. It occurs in implanted globules about an inch and a half through, consisting within of the Xanthophyllite, also in columnar and lamellar individuals which sometimes contain within thin tabular crystals of a hexagonal form, secondary apparently to a rhombic prism. *Cleavage* basal, highly perfect.

Composition, according to Rose, Silica 16·41, alumina 43·17, magnesia 19·57, lime 14·50, protoxyd of iron 2·23, soda 0·62, loss or water 4·45. It comes from the Schischimskian mountains near Slatoust.

BRUCITE. MARGARITUS BRUCII.

Native Hydrate of Magnesia, Bruce's Min. Jour. i, 26. Native Magnesia, *Cleav*. Magnésie Hydraté, *H*.

Primary form, a hexagonal prism. *Secondary form*, a thin six-sided table with the terminal edges replaced by a low plane. (Unst.) *Cleavage* basal, highly perfect; usually in foliated plates; folia easily separable.

H = 1·5 G = 2 35, Haidinger. *Lustre* pearly. *Streak* white. *Color* white, inclining to gray, blue, or green. Translucent—subtranslucent. Sectile. Thin laminæ flexible.

Composition, according to Bruce, (Min Journ 1, 26,) Fyfe, Vauquelin, (Ann. du Mus d Hist. Nat xx, 167,) Stromeyer, (Untersuchungen, p 467,) and Thomson, (Min 1, 157)

	Hoboken	Hoboken	Hoboken	Swinaness	Hoboken	Swinaness
Magnesia,	70	69 75	64 0	66 67	68 345	67 98
Water,	30	30 25	29 0	30 39	30 902	30 96
Perox mang	—	—	—	1 57	0 637	1 57
Protox iron,	—	—	2 5	1 18	0 116	
Lime,	—	—	—	0 19	—	—
Silica,	—	—	2 0	—	—	—
	100, B	100 00 F	97 5, V	100 00 S	100 000 S	100 51 T

Before the blowpipe it loses weight, becomes opaque and friable, but does not fuse Entirely soluble in the acids without effervescence

Obs Brucite accompanies other magnesian minerals in serpentine Occurs in considerable veins traversing serpentine, at Swinaness in Unst, one of the Shetland isles, where it is sometimes found in regular crystals It is also found in the same rock at Hoboken N J, opposite the city of New York, in veins which are sometimes an inch in width, also in Richmond Co, N Y, and on the peninsula east of New Rochelle, Westchester Co This mineral was discovered and described by the late Dr Bruce of New York

TALC Margaritus prismaticus

Prismatic Talc Mica, *M* Soapstone Steatite Speckstein

Primary form, a right rhombic prism, M : M=120° *Secondary form*. rectangular prisms and hexagonal plates *Cleavage* perfect parallel with P. *Imperfect crystallizations* · globular and stellated groups; also massive, structure granular, often impalpable. Occasionally the particles are strongly coherent, and the mineral has a slaty structure.

H.=1—1·5. G.=2 697—2 85. *Lustre* pearly. Some massive varieties, but slightly pearly or nearly earthy. *Streak* usually white; of some dark-green varieties, a little lighter than the color *Color* apple-green, passing into white, sometimes silvery-white; also inclining to greenish-gray and dark-green. Sometimes the laminæ are bright green, viewed perpendicular to the cleavage surface, and of a brown tinge, and less translucent at right angles with this direction. Subtransparent—subtranslucent. *Fracture* of highly crystalline varieties not observable. Sectile in a high degree. Thin laminæ easily flexible, but not elastic. *Feel* greasy.

The following are the principal varieties of this species

Foliated Talc Purest crystalline talc, consisting of easily separated folia, having a greasy feel, and presenting light green, greenish-white, and white colors

Soapstone or steatite, (Speckstein of the Germans) Coarse gray and grayish green massive varieties, generally granular *Pot stone*, or *Lapis ollaris*, includes the coarser granular specimens of dark color

Indurated Talc An impure, slaty talc, with a nearly compact texture, and superior hardness to common talc

Talcose Slate A dark slaty rock, having a greasy feel, consisting largely of talc, mixed with more or less of feldspar or quartz.

Rensselaerite, (Emmons.) A compact fine-grained massive steatite, often translucent in thin slabs, and presenting white, gray, yellowish and dark colors, sometimes nearly black It occurs frequently under the forms of pyroxene and is supposed to have resulted from the alteration of that rock (See under *Pyroxene* for its composition) H=4 G=2 871

Composition, according to Berthier, (Ann des M vi, 451,) v Kobell, (Kastner's Arch xii 29) and Lychnell (Pogg xxxviii)

	Fol Talc fr Kl. Bernhard	Fol Talc fr Proussiansk,	Fol Talc fr Greiner.	Steatite fr Gopfersgrun	Steatite, fr Sala
Silica,	58 2	62 80	62 8	65 64	63 13
Magnesia,	33 2	31 92	32 4	30 80	34 30
Protox iron,	4 6	1 10	1 6	3 61	2 27
Alumina,	—	0 60	1 0	—	—
Water,	3 5	1 92	2 3	—	—
	99 5 B	98 34, v K	100 1, v K	100 05, L.	99 70, L.

Pure Talc is an anhydrous silicate of magnesia Some analyses give for steatite 5 or 6 per cent of water, but Lychnell in his late investigations, obtained at the most but 1 per cent A pseudomorphous steatite, analyzed by Dewey, (Sill J vi, 333) afforded 15 per cent. of water Steatitic pseudomorphs are generally mixtures of a hydrous steatite with more or less of the mineral whose form they have This is the case with the hornblende and spinel steatitic pseudomorphs, examined by Beck, (Min N Y , pp 308, 318,) and also with the Rensselaerite, &c Before the blowpipe, talc loses its color, and fuses with difficulty With borax it forms, with intumescence, a clear glass, sometimes colored with iron

Obs This species is very generally diffused in primitive countries, and in some of its varieties especially common talc, potstone, and steatite, forms extensive beds in primitive regions, which are the repositories of several mineral species, among which are rhomb spar dolomite (var. bitter spar,) magnetic iron and actinolite

Apple green talc occurs in large foliated masses, in the island of Unst, one of the Shetland isles , also in the Gruner mountain in Saltzburg, and in the Vallais Other foreign localities are, of *potstone*, the Vallais and Grisons, and Wald, in Styria Pseudomorphs of steatite, imitative of quartz crystal, and also of calc spar, occur at Gopfersgrun in the principality of Bayreuth, which were at first supposed to be actual crystals of steatite.

Extensive beds of steatite occur in various parts of the New England States, also in New Jersey Pennsylvania, &c A bed at Smithfield, R. I, affords a delicate green columnar variety of talc, and a primitive limestone in the same region, a white granular variety At Bridgewater, Vt, handsome green talc occurs, intermingled with a transparent massive dolomite also at Dexter, Maine , Lockwood, Newton, and Sparta, New Jersey , near Amity, N Y ; on Staten Island, both common and indurated, near the quarantine , and four miles distant it occurs in detached masses made up of folia of a snow white color, (Beck ;) at Cooptown, Md , of green, blue, and rose color , in South Mountain, ten miles south of Carlisle, Penn

Pseudomorphs of steatite occur at Newton, New Jersey, imitative of quartz, scapolite, and spinel , also at Gouverneur, N Y , imitative of scapolite, in Orange Co , imitative of spinel and hornblende, and at Bergen hill, having the form of apophyllite

Slabs of steatite are extensively employed as fire stones in furnaces and stoves, for which purpose it is well adapted, on account of its extreme infusibility, and its slow conduction of heat Venetian talc is used for removing oil-stains from woolen cloth.

SAPONITE MARGARITUS SAPO

Piotine Steatite Soapstone Seifenstein

Massive. Soft almost like butter, but becomes brittle after drying Lustre greasy. Color white, yellowish, bluish, and reddish-white.

Composition according to Klaproth and Svanberg, (K V Ac H 1840)

Silica,	45·00	46·8
Magnesia,	24·75	33·3
Alumina,	9·25	8·0
Peroxyd of iron,	1·00	0·4
Potash,	0·75	Lime, 0·7
Water,	18·00=98·75, K.	11·0=100·2, S.

Saponite is wholly soluble in sulphuric acid. Gives out water and blackens before the blowpipe. Thin splinters fuse with some difficulty on the edges.

OBS. Occurs at Lizard Point, Cornwall. When first extracted, it may be kneaded like dough, but on exposure it loses part of its moisture and becomes subtranslucent.

A mineral in external characters like saponite, occurs in the geodes of datholite at Roaring brook, near New Haven, Conn.

Piotine of Svanberg, (Pogg. liv, 267, 1841.) Resembles saponite in external characters. *Composition*, Silica 50·891, magnesia 26·520, lime 0·777, alumina 9·401, peroxyd of iron 2·058, water 11·065=100·712. The name is from πιοτης, *fat*.

CHLORITE. MARGARITUS OLIVACEUS.

Talc Zographique, *H.* Chlorite slate. Ripidolite, *Kobell.* Chlorophæite.

Primary form, hexagonal. *Cleavage* parallel with the base and highly perfect. *Imperfect crystallizations:* in radiated forms, and massive, of a granular texture, or earthy.

H.=1·5. G.=2·65—2·85. *Lustre* vitreous to pearly. *Color* emerald-green, seen in the direction of the axis, and yellowish or hyacinth-red, at right angles with it. Massive varieties olive-green. Transparent—subtranslucent. Laminæ not elastic.

Composition, according to Kobell, (Erdmann's Jour. xvi, 470,) and Várrentrapp, (Pogg. xlviii, 185,)

	Achmatowsk.	Achmatowsk.	Schwarzenstein.	Gotthard.	Rauris.
Silica,	30·376	31·14	32·68	25·367	26·06
Alumina,	16·966	17·14	14·57	18·496	18·47
Magnesia,	33·972	34·40	33·11	17·086	14·69
Prot. iron,	4·374	3·85	5·97	28·788	26·87
Prot. manganese,	——	0·53	0·28	——	0·62
Water,	12·632	12·20	12·10	8·958	10·45
Undecomposed,	——	0·85	1·02	——	2·24
	98·310, V.	100·11, K.	99·73, K.	98·698, V.	99·40, K.

The above analyses, as observed by Kobell, appear to indicate that there are two distinct species here included. Kobell's separates the last two, together with a chlorite from Zillerthal, under the name *Ripidolite*, (from ριπις, *a fan*,) and to these species the specimens from Gotthard, as Rose remarks, also belong. No external characters are yet given, sufficient to distinguish the species; (see Erdmann's Jour. and Poggendorf, already referred to.) It is completely decomposed by sulphuric acid.

Chlorite fuses with difficulty in the thinnest splinters.

OBS. Chlorite forms extensive beds in primary regions, and is the characterizing ingredient of chlorite slate. Octahedral crystals of magnetic iron and hornblende are the most common minerals in chlorite and chlorite slate.

Chlorite occurs in various parts of the Eastern States. In Pennsylvania, crystals seven eighths of an inch in diameter have been observed by Mr. John Phillips.

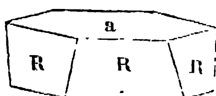
The *Prasilite* of Thomson (Phil. Mag. xxii, 193, 1843) is a soft, leek-green fibrous mineral, occurring in amygdaloid, consisting, according to Thomson, of Silica 38·55, magnesia 15·55, lime 2·55, peroxyd of iron 14·90, oxyd of manganese 1·50, alumina 5·65=96·70. It comes from the Kilpatrick Hills, Scotland.

Leuchtenbergite. This species, proposed by A. Komonen, (Verhand. der Kais-Russ. Min. Ges. zu St. Petersburgh, 1842, p. 64,) is allied in composition to chlorite. It is

foliated or foliated granular, and presents traces of a rhombohedral form, with a basal cleavage. H.=2·5. G.=2·71. Color yellowish, or white in thin folia, which are transparent; lustre pearly. *Composition*, according to Komonen, Silica 34·23, alumina 16·31, magnesia 35·36, peroxyd of iron 3·33; lime 1·75, water 8·68=99·66. Forms a colorless glass with borax, and a bead with salt of phosphorus, which is bottle green while hot, and colorless on cooling. Leuchtenbergite comes from the Schischimskian mountains, near Slatoust in the Ural. It was named by Maj. Jevreinoff in honor of Max. Leuchtenberg.

PENNINE. MARGARITUS RHOMBOHEDRUS.

Pennin, *J. Fröbel* and *E. Schweizer*, Pogg. l, 523, 526.



Crystallization rhombohedral. Occurs in tabular crystals, like the figure; R : R=118°, a : R=99° and 81°. *Cleavage* basal, eminent. Thin leaves flexible, but not elastic. *Imperfect crystallizations:* oblong masses with transverse striæ.

H. of a=2—2·5; of R=3. *Lustre* vitreous-pearly—submetallic; of the face R, greasy. *Color* of R, brown to hyacinth-red; in the direction of the axis by transmitted light, between emerald and leek-green; by reflected light, blackish-green. Thin pieces transparent.

Composition, according to Schweizer,
Silica 33·07, protoxyd of iron 11·36, alumina 9·69, magnesia 32·34, water 12·58=99·04.
Dissolves in muriatic or nitric acid, but not in sulphuric acid. Heated in a glass tube, it gives out pure water. In the platina forceps, it fuses on the edges with some intumescence to a yellowish-white enamel. With borax it forms easily a clear glass colored with iron. With soda on coal it fuses with intumescence to a brownish-yellow slag.

OBS. Pennine occurs in the Pennine Alps near Zermatt, in a rock which has been variously called mica slate or chlorite slate, but consists of Pennine and brown idocrase or garnet, and contains crystals of these minerals.

Frobel remarks that Breithaupt's *dichromatischer Aftenglimmer* from Binden in Switzerland, and Necker's hydro-talc from the Vallée de Binn, are without doubt identical with Pennine. The name Pennine is derived from its locality.

The *Pihlite* of Sefstrom from Fahlun, is a doubtful species as intermediate in its characters between talc and mica, (Phil. Mag. xvii, 479, 1840.)

PYROPHYLLITE. MARGARITUS EXFOLIANS.

Foliated. Massive, with a radiated structure like some varieties of talc.

H.=1. *Lustre* pearly, inclined to greasy. *Color* white, apple-green, grayish and brownish-green, ochre-yellow. Subtransparent—subtranslucent.

Composition, according to Herrmann, (Pogg. xv, 592,) Silica 59·79, alumina 29·46, magnesia 4, peroxyd of iron 1·8, water 5·62=100·67.

Alone before the blowpipe it swells up and spreads out in a fan-like shape, and increases to twenty times its former bulk. Infusible. With soda it forms a clear yellow glass. With nitrate of cobalt it assumes a fine blue color.

Pyrophyllite occurs in the Uralian mountains between Pyschminsk and Beresof. It was considered a radiated talc.

The *Vermiculite* of Milbury, Massachusetts, is probably identical with pyrophyllite, as shown by Mr. J. E. Teschemacher, (Proceed. Bost. Nat. Hist. Soc. 1843.) The mineral so called is a mechanical mixutre, consisting of grayish-green foliated scales looking like talc or mica in a grayish-white mealy base. The following is the result of an analysis by Dr. Thomson, but for the reason just stated it is unsatisfactory: Silica 49·080, magnesia 16·964, protoxyd of iron 16·120, alumina 7·280, water 10·276=99·720. Before the blow-pipe it does not fuse, but instantly shoots out into worm-like projections, consisting of the separated folia, and arising from the disengagement of water. According to Dr. A. A. Hayes, it dissolves with borax, forming a transparent yellow glass, which becomes green in the reducing flame. Forms a globule containing silica with salt of phosphorus, which is yellow while hot, and becomes colorless on cooling. Gives a blue color with nitrate of cobalt.

ORDER V. CHALICINEA.

MARGARITE. MICA MARGARINA.

Rhombohedral Pearl Mica, *M.* Perlglimmer, *L.*

Primary form, a hexagonal prism. *Cleavage:* basal, highly perfect; lateral, in traces. Usually in thin crystalline laminæ, irregularly intersecting each other.

H.=3.5—4.5. G.=3.032. *Lustre* pearly on P, vitreous on the other faces. *Streak* white. *Color* pale pearly-gray, passing into reddish-white and yellowish-white. Translucent—subtranslucent. Rather brittle.

Composition, according to du Menil,

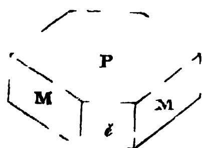
Silica,	37.00
Alumina,	40.50
Oxyd of iron,	4.50
Lime,	8.96
Soda,	1.24
Water,	1.00
Loss,	6.80=100

Intumesces and fuses before the blowpipe.

OBS. Margarite occurs at Sterzing in the Tyrol, in primitive rocks, mixed with and engaged in foliated chlorite, and associated with apatite and crichtonite.

COMMON MICA. MICA OBLIQUA.

Hemi prismatic Talc Mica, *M.* Biaxial Mica. Glimmer *of the Germans.*



Primary form, an oblique rhombic prism; M : M=119°—121°, P : M=98° 40′; some specimens 114°—115°, (Beck.) *Secondary form*, the primary with the acute lateral edges truncated. M : ĕ=120°. *Cleavage* eminent parallel to P, occasionally a diagonal cleavage in one direction tolerably perfect. *Compound crystals: of the first kind*, in which composition has taken place parallel to M; frequently, composition takes place parallel to two or more lateral planes, producing compound crystals of several individuals having a stellated appearance. *Imperfect crystallizations:* occasionally rough glo-

bular forms, composed of lamellar particles. Massive varieties usually have a lamellar composition, and are often composed of small aggregated scales, and sometimes arrayed in plumose forms.

H.=2—2·5. G.=2·832—3. *Lustre* more or less pearly. *Streak* white or gray. *Color* white, gray, pale-green, and violet-yellow, sometimes brown and dark olive-green. Transparent—translucent. Thin laminæ flexible and elastic, very tough. Sectile.

Composition, according to Rose and Meitzendorf, (Pogg. lvii, p. 158,)

	Broddbo.	Kimito.	Utön.
Silica,	46·10	46·358	47·50
Alumina,	31·60	36·800	37·20
Potash,	8·39	9·220	9·60
Perox. of iron,	8·65	4·533	3·20
Perox. of mang.	1·40	0·002	0·90
Fluoric acid,	1·12	0·705	0·56
Water,	1·00	1·840	2·63
	98·26, R.	99·518, R.	101·59, R.

The variety composed of scales arranged in plumose forms is called *plumose mica;* and that with the diagonal cleavage, *prismatic mica.*

Common mica does not fuse before the blowpipe, but only loses its transparency and becomes white.

Obs. Mica is one of the constituents of granite, and its associate rocks, gneiss and mica slate. It also occurs in more recent aggregate rocks; also in imbedded crystals in granular limestone, wacke, trachyte, and basalt. Coarse lamellar aggregations often form the matrix of crystals of topaz, tourmaline, and other mineral species.

Siberia affords laminæ of mica, sometimes exceeding a yard in diameter.

Fine crystallizations of mica occur in granite, at Acworth and Alstead, N. H., and Paris and Streaked Mountain, Maine; also in Massachusetts, at Chesterfield with tourmaline and albite, Barre and South Royalston with beryl, and at Mendon and Brimfield. A green variety occurs at Unity, Me., on the estate of James Neal; and prismatic mica at Russel, Mass.

In New York, in Orange Co., near Greenwood furnace, it occurs in oblique prisms sometimes six or seven inches in diameter, with the angle P : M 114° or 115°; six miles southeast of Warwick, crystals and plates sometimes a foot in diameter, in a vein of feldspar; a mile northwest of Edenville in six-sided and rhombic prisms; a silvery mica near Edenville; at Wilk's or Clove mine, near the banks of Muscalonge lake, Alexandria, Jefferson Co., in regular crystals. In St. Lawrence Co. eight miles from Potsdam, on the road to Pierrepont, in plates seven inches across; town of Edwards in large fine prisms, six-sided or rhombic; Greenfield near Saratoga, in reddish-brown crystals with chrysoberyl; on the Croton aqueduct near Yonkers, in rhombs with a cleavage in the direction of the shorter diagonal.

In New Jersey, good crystals are obtained at Newton and Franklin. In Pennsylvania near Germantown on the Schuylkill, black hexagonal crystals; on the Wilmington road near the woodlands; a green variety at Chesnut Hill, near the Wichichon. In Maryland, at Jones's Falls, a mile and three quarters from Baltimore; the plates show by transmitted light a series of concentric hexagons, the sides of which are parallel with the sides of a hexagonal prism; they are owing to a regular arrangement of the impurities in the crystals produced at the time of crystallization.

When quite thin, the laminæ of mica are often transparent, and have been used in Siberia for windows. It is hence sometimes called Muscovy glass. It however soon loses its transparency on exposure, and is but a poor substitute for the valuable product of art in general use. It is also used on board the Russian naval vessels, as it is less liable to fracture with the concussion produced by the discharge of heavy artillery. It is in common use for the doors of anthracite stoves, and for lanterns.

Fuchsite. Fuchsite is a chrome mica from the *Zillerthal,* containing 3·95 per cent. of oxyd of chromium, (Ann. d. Chem. u. Pharm. xliv, 40.)

HEXAGONAL MICA. Mica hexagonus.

Rhombohedral Talc-Mica, *M.* Uniaxial Mica. Magnesia Glimmer. Rubellan, *Breit.*

Primary form, a hexagonal prism. It occurs usually in six-sided prisms. *Cleavage:* basal, highly eminent. Also common in foliated masses.

H.=2—2·5. G.=2·8—3·1. *Lustre* pearly; often submetallic on the terminal faces of the prism: splendent—shining. *Streak* gray, or white. *Color* commonly dark-green or brown; often appearing nearly black, in thick masses. Transparent—opaque. Sectile. Thin laminæ flexible, and very elastic.

Composition, according to Klaproth, (Beit. v, 69,) and H Rose,

	Black, from Siberia.	Siberia.	
Silica,	42·5	42·50	40·00
Alumina,	11·5	16·05	12·67
Magnesia,	9·0	25·97	15·70
Potash,	10·0	7·55	5·61
Peroxyd of iron,	22·0	4·93	19·03
Oxyd of mang.	2·0	——	0·63
Fluoric acid,	——=97, K.	7·55=104·55, R.	2·10=95·74, R.

Before the blowpipe, it becomes white and opaque; sometimes it fuses to a scoria.

Obs. This species was long confounded with the preceding. Its distinctive characters were first discovered by an examination with polarized light, in which it exhibits but one axis of double refraction, or one system of rings, a fact inconsistent with the primary form of common mica. It also differs from that species in its composition, as it contains magnesia, which is not a constituent of the preceding species.

Hexagonal mica occurs in primary rocks, and also in basalt and trachyte.

The most remarkable varieties of this species are the dark-colored micas from Siberia; and the deep brown and perfect hexagonal prisms, of gem-like brilliancy and transparency, which occupy the cavities of the ejected lavas of Vesuvius.

Fine hexagonal prisms occur at the Middletown feldspar quarry, with crystallized albite: also near Henderson, Jefferson Co., N. Y., yellow or copper colored, often in large crystals; on the banks of Vrooman lake, near Oxbow, in large prisms of a light copper color, usually tapering towards one extremity; at Pope's mill on Fish creek, in Morristown, St. Lawrence Co., prisms sometimes six inches in diameter; in Rossie, two miles north of Somerville, a beautiful copper colored mica in white limestone; near Germantown, Penn., in black crystals.

All the localities of this species have not been distinguished from those of *Common Mica.*

The mica from Henderson Co., N. Y., has been examined by Dove, and found to be biaxial in its optical properties, although having the exterior characters of hexagonal mica. In composition it is closely allied to the uniaxial mica, as determined by Meitzendorf, (Pogg. lviii, 157, 1843,) as follows:

Silica 41·30, alumina 15·35, potash 9·70, peroxyd of iron 1·77, magnesia 28·79, fluoric acid and water 3·30, soda 0·65.

It should probably form a distinct species, with a right rhombic prism as its primary, and might be called *Rhombic Mica.*

LEPIDOMELANE.

Soltmann, Pogg. l, 664.

Minute six-sided tables—usually a slaty aggregate of small crystalline scales, seldom over half a line in size. The form, when dis-

tinct, is a regular hexagon, or very nearly regular. The scales were too small to observe cleavage or fracture.

H.=3. G.=3·000. *Lustre* of the scales adamantine, inclining to vitreous. *Streak* mountain-green. *Color* of the scales black—occasionally a leek-green reflection. Opaque, or translucent in very thin laminæ. Somewhat brittle.

Composition, according to Soltmann,

Silica 37·40, alumina 11·60, peroxyd of iron 27·66, protoxyd of iron 12·43, magnesia and lime, 0·26, potash 9·20, water 0·60=99·49.

Before the blowpipe, at a red heat, becomes pinchbeck-brown, and takes a metallic lustre, resembling the color and lustre of magnetic pyrites. Afterwards fuses to a black opaque shining enamel, attracted by the magnet. Dissolves easily with borax, and becomes a bottle-green color.

Obs. Occurs at Persberg in Wermeland. It was named, in allusion to its structure and color, from λεπις, *a scale*, and μελας, *black*. The *Siderischer Felsglimmer* or *Rabenglimmer* of Breithaupt is probably identical with this species, (Soltmann.)

LITHIA MICA. Mica rosea.

Lepidolite. Lithion-glimmer.

Primary form, a rhombic prism, (oblique ?) Occurs in hexagonal prisms of 119° and 122° nearly; also in coarsely granular masses. *Cleavage* basal, highly eminent.

H.=2·5. G.=2·89—3. *Lustre* pearly or metallic pearly. *Color* rose-red and gray. Translucent. Two axes of refraction.

Composition, according to Turner and Gmelin, and Rosales, (Pogg. lviii, 154,)

	Ural.	Chursdorf.	Zinnwald.	Cornwall.	Ural.	Ural.
Silica,	50·35	52·25	46·23	50·82	50·35	47·72
Alumina,	28·30	28·34	14·14	21·33	28·30	20·29
Peroxyd of iron,	——	——	17·97	9·08	——	Lime, 0·12
Protox. mang.	1·23	3·66	4·57	——	1·23	4·67
Potash,	9·04	6·90	4·90	9·86	9·04	10·96
Lithia,	5·49	4·80	4·20	4·05	5·49	2·77
Fluoric acid,	5·20	5·07	8·53	4·81	5·20	Fluorine, 10·22
Water,	——	——	0·83	——	——	Soda, 2·23
						Chlorine, 1·16
	99·61, T.	101·02, G.	101·37, G.	99·95, T.	99·61 T.	100·14, R.

Fuses easily to a white or grayish glass, which is sometimes magnetic, coloring the flame a purplish-red at the moment of fusion. Soda was first detected in this mineral in the analysis above quoted by Rosales, and it is supposed that it has been hitherto included with the lithia. The coarsely granular varieties, consisting of aggregated scales, are called *lepidolite*.

Obs. Chursdorf, Rozena, Zinnwald, Altenberg, and Cornwall, are some of the foreign localities.

In the United States, fine specimens are obtained at the albite vein in Chesterfield, Massachusetts, and at Goshen in the same State.

Lepidolite occurs at Paris, Maine, with red tourmalines, and often traversed by them; also near Middletown, Connecticut.

HYDROUS MICA. MICA HYDROSA.

Wasserglimmer, *Morin*, Ann. des Mines, xvii.

Primary form, a right rhombic prism. Two of the lateral edges usually replaced. Structure foliated like mica. Laminæ easily separable; flexible but not elastic. Scratched by the nail. *Lustre* of cleavage face brilliant; of lateral, dull: the former black. By transmitted light parallel to the laminæ, a distinct ruby color. *Feel* greasy.

Composition, according to Morin.

Silica,	34·8
Alumina,	10·2
Lime,	9·4
Magnesia,	1·8
Protoxyd of iron,	18·0
Deutoxyd of manganese,	5·0
Water,	14·4=98·9

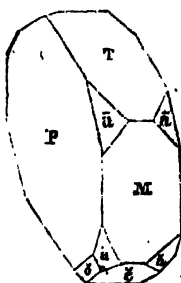
Gives off water when heated in a glass tube. Partly attacked by muriatic acid with the evolution of chlorine, but not at all by sulphuric acid.

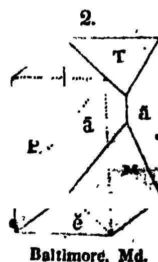
OBS. Hydrous mica was first observed at the foot of a glacier of Mont Rose: it has since been found at the Simplon and several other places in the Valais.

HEULANDITE. ZEOLUS RHOMBOIDEUS.

Hemi-prismatic Kouphone-Spar, *M.* Hemi-prismatic Zeolite, Foliated Zeolite, *J.* and *W.* Stilbite anamorphique, *Haüy.* Stilbite, (in part.) Blättriger Stilbit, *Haus.* Blätterzeolit, *W.* Euzeolith. Lincolnite, *Hitchcock.* Beaumontite, *Levy.*

Primary form, a right rhomboidal prism; M : T=130° 30′. *Secondary form*: M : ā=146°, T : ā=148°, P : ā=111° 56′, M :





Baltimore, Md.

ĕ=114° 20′, P : ā=133° 35′, ā : ā=136° 3′. *Cleavage* parallel with P highly perfect. *Imperfect crystallizations*: globular forms; also granular.

H.=3·5—4. G.=2·2, Haidinger; 2·195, Thomson, a crystal from the Faroe Islands. *Lustre* of P pearly; of other faces, vitreous. *Streak* white. *Color* various shades of white passing into red, gray, and brown. Transparent—subtranslucent. *Fracture* subconchoidal, uneven. Brittle.

Composition according to Walmstedt, (Edinb. Phil. Journ. vii, 11,) and Thomson, (Min. i, 347,)

	Campsie.	Faroe.
Silica,	59·90	59·145
Alumina,	16·87	17·920
Lime,	7·19	7·652
Water,	13·43=97·39, W.	15·400=100·117, T.

Intumesces and fuses in the blowpipe flame, and becomes phosphorescent. Dissolves in muriatic acid without gelatinizing.

OBS. Heulandite occurs principally in amygdaloidal rocks. It has been found also in metalliferous veins.

The finest specimens of this species come from Iceland and the Faroe Islands, and from the Vendayah mountains in Hindostan. The red varieties occur at Campsie, in Sterlingshire, with stilbite of the same color. At Arendal it is met with of a brown tint. It also occurs in the Kilpatrick hills, near Glasgow.

At Peter's Point, Nova Scotia, it occurs in trap, presenting white and flesh-red colors, and associated with Laumonite, apophyllite, Thomsonite, &c.; also at Cape Blomidon, and other places in the same region, in crystals an inch and a half in length.

In the United States it has been observed with stilbite and chabazite on gneiss, at Hadlyme, Ct., and Chester, Mass., and with these minerals and datholite, apophyllite, &c., at Bergen Hill, New Jersey; also at Kipp's Bay New York Island on gneiss, along with stilbite; also in minute crystals, seldom over half a line long, with Haydenite, at Jones' Falls, near Baltimore, on a syenitic schist. Levy has described these crystals under the name of *Beaumontite*, considering them modified square prisms. The difference in the lustre of P and ĕ, the two faces of the prism, shows that these planes are dissimilar, and that the form cannot be a square prism. In physical and other characters they resemble Heulandite, and the angle T : ă, according to Levy, equals 147° 18′, which is near the same angle in this species. Levy makes ă : ă=132° 20′.

This species was named by Mr. Brooke in honor of Mr. Heuland of London, to whom the science of Mineralogy is much indebted. It may be distinguished from stilbite by its crystalline form, and its more perfectly pearly lustre.

BREWSTERITE. ZEOLUS BREWSTERIANUS.

Megallogonous Kouphone Spar, *Haid.* Brewsterite, *Brooke*, Edin. Phil. Jour. vi, 112. Diagonite, *Br.*

Primary form, a right rhomboidal prism; M : T=93° 40′. *Secondary form:* M : e=176°, e : e=172°. *Cleavage* highly perfect parallel to P.

H.=5—5·5. G.=2·12—2·432; the latter according to Thomson. *Lustre* of P pearly; of other faces, vitreous. *Streak* white. *Color* white, inclining to yellow and gray. Transparent—translucent. *Fracture* uneven.

Composition, according to Dr. Thomson, (Min. i, 348.)

Silica,	53·045
Alumina,	16·540
Baryta,	6·050
Strontia,	9·005
Lime,	0·800
Water,	14·735=100·175

Before the blowpipe it parts with its water and becomes opaque; then froths and swells up, but fuses with difficulty. It leaves a silica skeleton when fused with biphosphate of soda. Dissolves in the acids with a separation of the silica.

OBS. Brewsterite was first observed at Strontian in Argyleshire, where it occurs associated with calcareous spar. It has since been discovered at the Giant's Causeway, coating the cavities of amygdaloid, in the lead mines of St. Turpet, near Freiburg in the Brisgau, in the department of the Isère in France, and in the Pyrenees.

This species was named in honor of Sir David Brewster.

LAUMONITE. ZEOLUS EFFLORESCENS.

Diatomous Kouphone-Spar, *M.* Diprismatic Zeolite, *J.* Lomonite, *W.* Laumontit, *L.* Laumonit, *H.* Efflorescing Zeolite.

Primary form, an acute oblique rhombic prism; M : M=86° 15′, P : M=66° 30′, or 113° 30′. *Secondary form:* similar to fig. 97, Pl. II: also with the edge between each M and ă replaced. *Cleavage* parallel to the acute lateral edge. Imperfectly crystalline varieties have a radiating or diverging structure.

H.=3·5—4. G.=2·3, Haüy. *Lustre* vitreous, inclining to pearly upon the faces of distinct cleavage. *Streak* white. *Color* white, passing into yellow or gray. Transparent—translucent, becomes opaque on exposure. *Fracture* scarcely observable, uneven. Not very brittle.

Composition, according to Vögel, (J. de Phys. lxxi, 64,) Gmelin, (Leonh. Jasch. xiv, 408,) and Connell, (Edinb. J. 1829, p. 282,)

		Huelgoet.	Skye.
Silica,	49·0	48·3	52·04
Alumina,	22·0	22·7	21·14
Lime,	9·0	12·1	10·62
Water,	17·5	16·0	14·92
Carbonic acid,	2·5=100, V.	——=99·1, G.	——=98·72, C.

Before the blowpipe it intumesces and fuses to a white frothy mass. With borax, it forms a transparent globule. It gelatinizes with nitric or muriatic acids, but is not affected by sulphuric acid, unless heated. If insulated, it acquires negative electricity by friction. On exposure to the air, it loses its water of crystallization, and becomes opaque, and in this state is easily pulverized by the fingers, and often falls to a powder of itself.

OBS. Laumonite occurs in the cavities of amygdaloid, also in porphyry and Syenite, and occasionally in veins traversing clay slate with limestone. It was first observed in 1785, in the lead mines of Huelgoet in Brittany, by Gillet Laumont, after whom it is named.

Its principal localities are at the Faroe Islands, Disko in Greenland, St. Gothard in Switzerland, the Fassa-thal in large masses exhibiting a radiated structure, Hartfield Moss in Renfrewshire accompanying analcime, the amygdaloidal rocks in the Kilpatrick hills near Glasgow, and in several trap rocks of the Hebrides, and the north of Ireland.

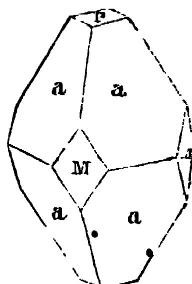
Peter's Point, Nova Scotia, affords fine specimens of this species. It is there associated with apophyllite, Thomsonite, and other species of this family.

Good Laumonite is obtained at Phipsburg, Maine, and the Charlestown quarries, Mass.; also at Bradleysville, Litchfield Co., Conn., near a paper-mill, in narrow seams in gneiss; and at Southbury, Conn., a little east of the village, on the land of Mr. Stiles. At Bergen Hill, N. J., it occurs in greenstone, along with datholite, apophyllite, &c. It has been found sparingly at Phillipstown, N. Y., in feldspar with stilbite, and at Columbia bridge, near Philadelphia.

The rapid decomposition to which this mineral is exceedingly liable, may be prevented by dipping the specimen in a thin solution of gum Arabic, by means of which it is preserved from contact with the air.

APOPHYLLITE. Zeolus quadratus.

Pyramidal Kouphone-Spar, *M.* Pyramidal Zeolite, *J.* Tesselite, *Brewster.* Ichthyophthalmite. Albin, *Wern.* Fischaugenstein, *Wern.* Mesotype Epointée, *H.*



Primary form, a right square prism. *Secondary form,* similar to fig. 51, Pl. I, also the annexed figure; a : a=104° 2′ and 121°, P : a=119° 30′, M : a=127° 59′. Another form, similar to fig. 51, Pl. I, except that the planes a, are so extended as to produce four-sided pyramids at each extremity of the crystal. Sometimes the crystals are nearly cylindrical and contracting in size towards each end, have a barrel-like shape. *Cleavage* highly perfect, parallel with P; less so parallel with M. The imperfectly crystalline varieties have usually a lamellar composition in the direction of P.

H.=4·5—5. G.=2·335, Haidinger, a variety from Iceland; 2·359, Thomson. *Lustre* of P pearly; of the other faces vitreous. *Streak* white. *Color* white, or grayish; occasionally with a shade of green, yellow, or red. Transparent—opaque. *Fracture* uneven. Brittle.

Composition, according to Stromeyer, (Untersuch. p. 286.) Berzelius, (Afhandl. vi, 181,) Turner, and Thomson, (Min. i, 353,)

	Fassa.	Faroe, *Tesselite.*	Oxahverite.	Uton.
Silica,	51·8643	51·76	50·76	51·008
Lime,	25·1992	22·73	22·39	26·236
Potash,	5·1369	5·31	4·18	5·888
Fluosil. of Lime,	——	3·53	trace	——
Water,	16·0438	16·20	17·36	16·500
	98·2442, S.	99·53, B.	94·69, Turn.	99·634, Th.

It exfoliates before the blowpipe, and ultimately fuses to a white vesicular glass. Melts easily with borax. In nitric acid it separates into flakes, and becomes somewhat gelatinous and subtransparent.

Obs. The term *tesselite* was applied by Brewster to a variety from Faroe, presenting nearly a cubical form, which, upon optical examination, exhibits a mosaic-like, or tesselated structure. *Oxahverite* is a pale green variety from the Oxahver springs, near Husavick in Iceland, where it occurs on calcified wood; it is generally indistinctly crystallized and translucent. *Albin,* of Werner, is a white, opaque variety, found at Aussig in Bohemia, associated with natrolite.

Greenland, Iceland, the Faroe Islands, and Poonah in Hindostan, afford fine specimens of apophyllite. It occurs at these localities coating the cavities of amygdaloid, associated with chalcedony, stilbite, chabazite, &c. At Andreasberg, it occurs in silver veins, traversing gray-wacke slate; in the Bannat, associated with Wollastonite. In Fifeshire, it has been found in large transparent crystals, occupying the interior of fossil shells. It is associated with magnetic iron, at Utön in Sweden. It occurs also at Puy-de-la-Piquette in Auvergne, where it occurs in crystals in a tertiary limestone, but appears to have been formed by contact with the adjoining basaltic rocks, subsequent to the deposition of the limestone.

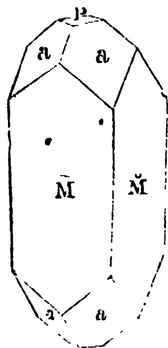
In America it has been found at Peter's Point and Patridge Island, in the Basin of Mines, Nova Scotia. It here occurs both massive and crystallized, presenting white, reddish, and greenish colors, and is associated with Laumonite, Thomsonite, and other min-

erals of trap rocks. Beautiful crystallizations occur in greenstone at Bergen Hill, N. J., associated with analcime, stellite, stilbite, datholite, &c. It is also found at Gin Cove, near Perry, Maine, with prehnite and analcime in amygdaloid.

Apophyllite was so named in allusion to its tendency to exfoliate under the blowpipe, from απο and φυλλον, *a leaf.* Its pearly lustre on the face of perfect cleavage, gave rise to the name *Ichthyophthalmite,* from the Greek ιχθυς, *a fish,* and οφθαλμος, *an eye.*

STILBITE. Zeolus fasciculatus.

Prismatoidal Kouphone-Spar. *M.* Radiated Zeolite. *J.* Foliated Zeolite, Strahlzeolith. *W.* Blättrich-strahliger Stilbite. *Haus.* Spherostilbite, *B.* Hypostilbite, *B.* Desmine.



Primary form, a right rectangular prism. *Secondary form,* the annexed figure; a : a=119° 15′, M̄ : a=120° 30′. Frequently the lateral edges are replaced, and M̄ : *e*=136° 30′. *Cleavage* parallel to M̆ perfect, to M̄ less so. *Compound crystals* of a cruciform character are rarely met with. *Imperfect crystallizations:* sheath-like aggregations of crystals; globular, divergent, and radiated forms; also columnar or thin lamellar.

H.=3·5—4. G.=2·133—2·143, Thomson; 2·161, Haidinger. *Lustre* of M̆, both as faces of crystallization and cleavage, pearly; of other faces, vitreous. *Streak* white. *Color* white; occasionally yellow, brown, or red. Subtransparent—translucent. *Fracture* uneven. Brittle.

Composition, according to Dumenil, (Schweig. Jahrb. vi, 163,) Thomson, (Min. i, 345,) and Beudant.

		Red Dumbarton.	*White.*	*Spherostilbite*	*Hypostilbite.*
Silica,	52·25	52·500	54·805	55·91	52·43
Alumina,	18·75	17·318	18·205	16·61	18·32
Lime,	7·36	11·520	9·830	9·03	8·10
Soda,	2·39	——	——	0·68	2·41
Water,	18·75	18·450	19·000	17·84	18·70
	99·50, *D.*	99·788, T.	101·840, T.	100·07, B.	99·96, B.

Zellner obtained for a stilbite from Pangelberg in Silesia, (Isis, 1834, p. 367,) Silica 60·27, alumina 14·13, lime 6·40, magnesia 0·21, water 18·50—99·71.

Before the blowpipe, it yields a colorless glass. Does not gelatinize except after a long exposure to, and frequent boiling in nitric acid.

Obs. Stilbite occurs mostly in cavities in amygdaloid or trap. It is also found in some metalliferous veins, and on granite and gneiss.

Stilbite is met with in great abundance on the Faroe Islands in Iceland, and the Isle of Skye, in trap. At Andreasberg in the Hartz, and Kongsberg and Arundel in Norway, it occurs in veins and beds of iron ore. Judore in the Vendayah Mts. in Hindostan, affords large translucent crystals, having a reddish tinge. Fine crystals, of a brick-red color, occur in porphyritic amygdaloid, near Kilpatrick in Dumbartonshire. A brown variety occurs on granite, at the copper mines of Gustafsberg, near Fahlun in Sweden. At Patridge Island, Nova Scotia, this species forms a perpendicular vein from three to four inches thick, and from thirty to fifty feet long, intersecting amygdaloid. Its colors are white and flesh-red. It is accompanied with wine-colored carbonate of lime. The specimens there obtained are exceedingly beautiful.

Stilbite is not an abundant mineral in the United States. It occurs sparingly in small crystals at Chester and the Charlestown Syenite quarries, Mass.; at the Gneiss quarry, Thatchersville, Conn., in crystals lining cavities in coarse granite; at Hadlyme in radiated

forms on gneiss, associated with epidote, garnet, and apatite; at Phillipstown, N. Y., in crystals or fan-like groups; opposite West Point, in a vein of decomposing bluish feldspar, intersecting gneiss, in honey-yellow crystals; in the greenstone of Piermont, N. Y., in minute crystals; in scopiform crystals of a dull yellow color, near Peekskill, N. Y.; and at Bergen Hill, New Jersey, in small but bright crystals.

The name stilbite is derived from στιλβη, *lustre.*

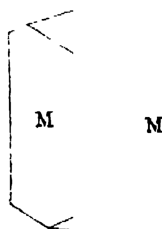
Stilbite is easily distinguished from the preceding species, by its property of not gelatinizing with acids; and from gypsum, which it sometimes resembles, by its superior hardness.

Caporcianite, (*Savi,—Anderson.* Jameson's Jour. No. 67, p. 21, 1842.) Caporcianite is a grayish-red zeolite, occuring in radiated masses, and was found by Savi, near the village of Monti Catini, in Tuscany. According to Anderson it consists of Silica 52·8, alumina 21·7, peroxyd of iron 0·1, lime 11·3, magnesia 0·4, potash 1·1, soda 0·2, water 13·1=100·7. In composition it is allied to stilbite, &c.

A red zeolite from Aedelfors in Smaland, described by Retzius under the name of *Edelforsite,* consists of Silica 60·280, alumina 15·416, lime 8·180, peroxyd of iron 4·160, magnesia and oxyd of manganese 0·420, water 11·070=99·526. It agrees in composition with stilbite, except that it contains two per cent. less of water, (*Ramm.*)

EPISTILBITE. ZEOLUS ACUTUS.

Diplogenic Kouphone-Spar. *Haid.* *Rose,* in Brewster's Jour. iv, 283. Monophan, *Breit.*



Primary form, a right rhombic prism; M : M=44° 50′, and 135° 10′. *Secondary form,* M : ē=112° 25′, *a* : ē=106° 10′, a : a=109° 46′, M : a=122° 9′. *Cleavage* parallel to the shorter diagonal, perfect; indistinct in other directions. Face M mostly uneven. Presents occasionally twin crystals of *the first kind.* Also granular.

H.=4—4·5 G.=2·249—2·25. *Lustre* pearly upon the cleavage face; upon M vitreous. *Streak* and *Color* white. Transparent—subtranslucent. *Fracture* uneven.

Composition, according to Rose,

Silica,	58·59	60·28
Alumina,	17·52	17·36
Lime,	7·56	8·32
Water,	14·48	12·52
Soda,	1·78=99·93	1·52=100·00

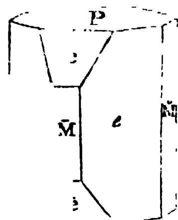
Froths in the blowpipe flame, and forms a vesicular enamel, but does not fuse to a globule. Borax dissolves a great part of it, and forms a clear globule. It is also soluble in salt of phosphorus, with the exception of a skeleton of silica. It is soluble in concentrated muriatic acid, with the exception of a fine granular residue of silica.

OBS. Epistilbite is associated with scolecite at the Berufiord in Iceland, and is also found at Poonah in India. It occurs with stilbite, apophyllite, &c. at Bergen Hill, N. J.

This species was separated from stilbite by Dr. G. Rose, of Berlin, from which it is distinct in crystallization. It is also peculiar in exhibiting but one system of rings in polarized light, as was determined by Dr. Brewster. The double refraction of Heulandite, is also much greater than that of epistilbite.

THOMSONITE. ZEOLUS THOMSONIANUS.

Orthotomous Kouphone-Spar, *M.* Mesotype (in part) *of Hauy.* Needle Zeolite (in part) *of Werner.* Comptonite. Chalilite, *Thom.* Triploklas, *Br.*



Primary form, a right rectangular prism. *Secondary form*, the annexed figure; M̄ : e=135° 20′, M̄ : e=134° 40′, P : $\bar{e}$=125°. *Cleavage* parallel to M̄ and M̄ easily obtained. *Imperfect crystallizations:* columnar radiated structure; also amorphous.

H.=4·75. G.=2·3—2·4; 2·35—2·38, (Comptonite,) Zippe. *Lustre* vitreous, inclining to pearly. *Streak* white. *Color* snow-white: impure varieties brown. Transparent—translucent. *Fracture* uneven. Brittle.

Composition, according to Berzelius, (Ed. J. vii, 9,) Rammelsberg, (Pogg. xlvi, 288,) Melly, (Bib. Univ. N. ser. xv, 193,) and Thomson, (Min. i, 324.)

	Thomsonite, Kilpatrick.	*Comptonite*, Bohemia.	*Comptonite*, Elbogen.		*Chalilite*.
Silica,	38·30	38·735	37·00		36·56
Alumina,	30·70	30·843	31·07		26·20
Lime,	13·54	13·428	12·60		10·28
Soda,	4·53	3·852	6·25		2·72
Water,	13·10	13·097	12·24		16·66
Potash,	——	0·542	——	Perox. of iron,	9·28
	100·17, B.	100·497, R.	99·16, M.		101·70, T.

According to Franenheim Thomsonite is isomorphous with *Harmotome.*

Intumesces before the blowpipe, becoming white and opaque; the edges merely are rounded at a high heat. When pulverized it gelatinizes with nitric or muriatic acid.

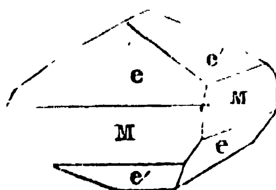
OBS. Thomsonite occurs near Kilpatrick and Lochwinnoch, Scotland, in amygdaloid. Comptonite (shown by Rammelsberg to be Thomsonite) is met with in the lavas of Vesuvius, in basalt at the Pflaster Kaute near Eisenach in Hessia, at Leitmeritz, Hauenstein and Seeberg in Bohemia, in the cavities of clinkstone, and in the Cyclopean islands, Sicily, with analcime and Phillipsite.

Long slender prismatic crystallizations of a grayish-white color are obtained at Peter's Point, Nova Scotia, where it is associated with apophyllite, mesotype, laumonite, and other trap minerals.

Scoulerite of Thomson, is near Thomsonite in composition, but contains less alumina and water and 6½ per cent. of soda. It comes from Port Rush in Ireland, (Phil. Mag. 1840, Dec. 402.)

EDINGTONITE. ZEOLUS HEMIQUADRATUS.

Hemi-pyramidal Feldspar, *Haid.*, Brewster's Journ. iii, 316. Antiedrit, *Br.*



Primary form, a right square prism. *Secondary form*, a hemihedral crystal, the upper and lower basal edges of the same lateral face being differently modified. M : e′ =115° 26′, e′ : e′ (over the summit)=129° 8′. M : e=133° 39½′. e : e (over the summit)=92° 41′. *Cleavage* parallel to M perfect.

H.=4—4·5. G.=2·7—2·75. *Lustre* vitreous. *Streak* white. *Color* grayish-white. Translucent. Brittle.

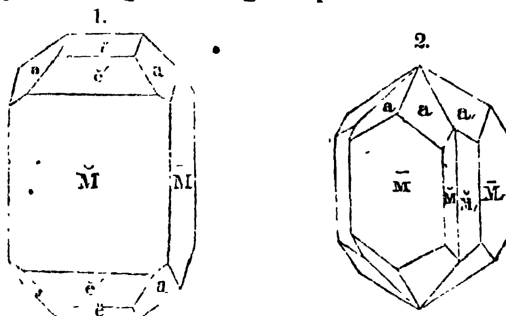
Composition, according to an imperfect analysis by Dr. Turner, (Brewster's J. iii, 318,) Silica 35·09, alumina 27·69, lime 12·68, water 13·32, and, as Dr. T. supposes, 10 or 11 per cent. of some alkali: the quantity of the mineral subjected to analysis was too small to afford confident results. At a high heat, before the blowpipe, it fuses to a colorless mass, having first given off water, and become white and opaque.

Obs. Edingtonite was first observed by Mr. Haidinger, in small but distinct crystals, on a specimen of Thomsonite from Dumbartonshire, in the collection of Mr. Edington, of Glasgow. It is extremely rare.

HARMOTOME. Zeolus gemellus.

Paratomous Kouphone Spar, *M.* Staurolite, *Kirwan.* Andreolite. Andreasbergolite. Ercinite. Kreuzstein, *W.* Harmotome, *H.*

Primary form, a right rectangular prism. *Secondary form:*



a : a (adjacent)=121° 27′, ĕ : a=150° 44′, M̆ : ĕ=124° 23′, Mohs. *Cleavage* parallel to M̄ and M̆ imperfect. *Compound crystals:* fig. 2, composed of four individuals, united according to composition of the *third kind*. These forms are of frequent occurrence. Also, in twins consisting of three individuals crossing at 90°, and producing nearly the form of the rhombic dodecahedron. Rarely massive.

H.=4—4·5. G.=2·39—2·448. *Lustre* vitreous. *Streak* white. *Color* white; passing into gray, yellow, red, or brown. Subtransparent—translucent. *Fracture* uneven, imperfectly conchoidal. Brittle.

Composition, according to Köhler, (Pogg. xxxvii,) Connell, (Jameson's Ed. J. 1832, p. 83,) and Thomson, (Min. i, 350,)

	Andreasberg.	Strontian.	Strontian.
Silica,	46·626	47·04	48·753
Alumina,	16·823	15·24	15·100
Baryta,	20·324	20·85	14·275
Lime,	0·256	0·10	3·180
Potash,	1·025	0·88	2·550
Soda,	——	0·84	——
Perox. iron,	——	0·24	——
Water,	15·030=100·084, K.	14·92=100·11, C.	14·000=97·858, T.

Before the blowpipe, on charcoal, it melts without intumescence to a clear globule. Phosphoresces when heated, giving out a yellow light. Scarcely attacked by the acids, unless they are heated.

OBS. Harmotome occurs in metalliferous veins traversing gray-wacke, also on gneiss, and in the cavities of amygdaloid.

Strontian in Argyleshire, affords the finest simple crystals of this species. They occur there on calcareous spar, and are sometimes an inch in diameter. This locality affords also specimens of the compound crystals. The latter, however, are more abundant in a metalliferous vein at Andreasberg in the Hartz. It also occurs at Oberstein in Deuxponts, coating the cavities of silicious geodes, at Kongsberg in Norway, on gneiss, and accompanying analcime in the amygdaloid of Dumbartonshire.

The name Harmotome is derived from 'αρμος, *a joint*, and τεμνω, *to cleave.*

PHILLIPSITE. ZEOLUS PHILLIPSIANUS.

Levy, Ann. Phil. 2d ser. x, 362. Staurotypous Kouphone-Spar, *M.* Lime-Harmotome. Kalk-Harmotome. Gismondine, Aricite, Zeagonite. Morvenite, *Thom.*

Primary form, a right rectangular prism. *Secondaries* and *twin crystals*, similar to those of harmotome; a : a=about 123° 30′, and 117° 30′, Levy.

H.=4—4·5. G.=2—2·2. *Lustre* vitreous. *Streak* white. *Color* white, sometimes reddish. Translucent—opaque.

Composition, according to Gmelin (Leonh. Zeits. 1825, I, 8) and Connel, (Jameson's Jour. Oct. 1843, p. 375,)

	Morbourg.	Morbourg.	Giant's Causeway.
Silica,	48·51	48·02	47·35
Alumina,	21·76	22·61	21·80
Lime,	6·26	6·56	4·85
Potash,	6·33	7·50	5·55
Protox. iron,	0·29	0·18	Soda, 3·70
Water,	17·23=100·38, G.	16·75=101·62, G.	16·96=100·21, C.

OBS. This species was united with the preceding, which it very much resembles, until Levy pointed out its peculiarities, and gave it the name it bears, in honor of Mr. W. Phillips. It differs chemically from harmotome in containing lime and potash, instead of barytes.

Dr. Thomson has separated another species from harmotome, which he calls *Morvenite*, or transparent harmotome, from Strontian. It occurs in rectangular prisms, with deeply replaced edges and angles. According to his measurement, M : e=124° 47′, M : e=145° 13′, e : a=149° 32′.

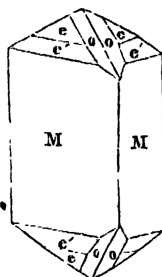
Phillipsite occurs in large translucent crystals in the cavities of amygdaloid, in the Giant's Causeway in Ireland, and in sheaf-like aggregations at Capo di Bove, near Rome: also in long crystals aggregated in radiating masses, at Aci Reale on the eastern coast of Sicily: among the Vesuvian lavas; and in the island Magee, county Antrim, in minute flesh-red crystals, coating cavities of amygdaloid.

Kobell and Brooke have shown that *Gismondine* (including Aricite and Zeagonite) should be united with this species. The crystals from Capo di Bove are brilliant, and resemble those of harmotome. The angles of the pyramid terminating the prism are about 121°. G.=2·18. *Composition*, according to Kobell, Silica 42·72, alumina 25·77, lime 7·60, potash 6·28, water 17·66. Carpi is supposed to have analyzed another mineral, (Erdmann's J. xvii; Phil. Mag. xx, 440.) Purple crystals (Zeagonite) occur in the drusy cavities of ice-spar, at Vesuvius.

NATROLITE. ZEOLUS RHOMBICUS.

Prismatic Kouphone-Spar, *M.* Prismatic Zeolite, or Mesotype, *J.* Mesotype, *P.*, *H.* Feather Zeolite. Faserzeolith, Natrolith, *W.* Crocalite. Edelite. Hoganite. Lehuntite, *Thom.* Radeolite.

Primary form, a right rhombic prism; M : M=91° 10′, according to Gehlen and Fuchs, and also Mr. Brooke; oblique rhombic according to Rose. *Secondary form*, M : e=116° 37′, e : e (adjacent planes)=126° 47′, e : e (over o)=143° 14′, e : o=178° 45′,



o : o=145° 44′, Brooke. Other secondaries exhibit only the terminal planes e, in connection with the lateral. The obtuse lateral edges are also frequently beveled or truncated; M : e (the truncating plane)=135° 35′. *Cleavage* parallel to M perfect. *Imperfect crystallizations:* globular, divergent, and stellated forms, composed of delicate acicular crystals, or slender laminæ. Also in dull friable masses, having an earthy fracture.

H.=4·5—5·5. G.=2·139—2·2303, Thomson. *Lustre* vitreous. *Streak* gray. *Color* white, inclining to yellow or gray; sometimes red. Transparent—translucent. *Fracture* uneven. Brittle.

Composition, according to Gehlen and Fuchs, (Schweig. Jour. xviii, 11,) and Thomson, (Min. i, 317,)

		Auvergne.	Antrim.
Silica,	48·0	48·04	47·560
Alumina,	26·5	25·03	26·420
Protoxyd of iron,	——	——	0·580
Soda,	16·2	16·76	14·932
Lime,	——	——	1·400
Water,	9·3=100, G. and F.	9·65=99·48, G. & F.	10·440=101·332, T.

Before the blowpipe it becomes opaque, gives off a phosphorescent light, and melts to a glassy globule. It dissolves in the acids, and forms a thick jelly; this will even take place after the mineral has been exposed to a red heat. It becomes electric by heat, and sometimes phosphoresces.

OBS. Natrolite was originally included, together with several other species, under the general name of Zeolite. From these it was distinguished by Hauy, who denominated it *mesotype*. Since then it has been discovered, both by analysis and crystallographic considerations, that the species *mesotype* included two distinct minerals; one of which was identical with *natrolite*, a mammillary mineral, from Högan, so named by Klaproth, and the other was named *scolecite*. The former is a *soda-mesotype*, and the latter a *lime-mesotype*. Still another species has been made on crystallographic examination and analysis, which is called *Mesole*, and *Mesolite* is proposed as a fourth.

Natrolite occurs in cavities in amygdaloidal and volcanic rocks, associated with analcime and chabazite.

Auvergne, the *graustein* of Aussig in Bohemia, the trap rocks of Kilmalcolm in Renfrewshire, and Glenarm in the county Antrim, are some of its foreign localities; also Duron in the Fassa valley, where it is met with in radiating groups of a fine red color.

Natrolite is met with in the trap of Nova Scotia; also in the same rock at Cheshire, Conn. At Washington, Conn., it is stated to occur in seams, between hornblende and gneiss. At Bergen Hill, N. J., it occurs in greenstone with stellite, analcime, &c.

Natrolite is so called from natron, *soda;* alluding to the soda it contains.

POONAHLITE. ZEOLUS POONAHLENSIS.

Brooke, Annals of Philosophy, August, 1831.

Primary form, a right rhombic prism; M : M=92° 20′.

H.=5—5·5. G.=2·1622. *Lustre* vitreous. *Color* white. Transparent—translucent.

Composition, according to Gmelin, (Pogg. xlix, 538, 1840,)
Silica 45·120, alumina 30·446, lime 10·197, soda and trace of potash 0·657, water 13·386 =99·806.

OBS. This species accompanies fine apophyllites, stilbites, &c., at Poohnah in Hindostan. It much resembles natrolite; but its crystals traverse the matrix, instead of forming groups in cavities, and have not been observed with perfect terminations. In composition it is near Scolecite.

MESOLE. ZEOLUS FLABELLIFORMIS.

Flabelliform Kouphone Spar, *Haid.* Brewster's Journal, vii, 18. Brevicite. Harringtonite, *Thom.*

Primary form, trimetric. Usually occurs in implanted globules, which have a flat columnar or lamellar structure, radiating from the centre. *Cleavage* perfect in one direction.

H.=3·5. G.=2·35—2·4. *Lustre* silky or pearly. *Streak* white. *Color* grayish-white; sometimes yellow. Translucent. Laminæ slightly elastic.

Composition, according to Hisinger and Berzelius, (Ed. Phil. Jour. vii, 7,)

	Sweden.	Faroe.
Silica,	42·17	42·60
Alumina,	27·00	28·00
Lime,	9·00	11·43
Soda,	10·19	5·63
Water,	11·79=100·15, H.	12·70=100·36, B.

OBS. Mesole occurs, coating the vesicular cavities of amygdaloid and basalt, at Nalsoe in the Faroe Islands, where it is associated with chabazite, apophyllite, stilbite, and others of the zeolite family. Also in Discoe Island, Greenland, in aggregations which bear much resemblance to crystallized spermaceti.

Mesole is distinguished from natrolite by its perfect single cleavage and pearly lustre; from stilbite or Heulandite, by its superior specific gravity; and from apophyllite, by its crest or fan-like aggregations, which are never presented by that mineral. When associated with apophyllite or stilbite, it forms the lowest stratum, immediately adjoining the rock in which it is situated.

Dr. Thomson has described a mineral under the name of *Harringtonite*, which is very similar in composition to mesole. It constituted a vein about 0·6 inch thick in amygdaloid, in the north of Ireland. Its description is as follows: *Color* snow-white; texture compact and earthy; *lustre* like that of the almond; opaque; very tough. *Composition*, (Min. i, 329,)

Silica,	44·960	44·840
Alumina,	26·848	28·484
Lime,	11·008	10·684
Protoxyd of iron,	0·880	trace.
Soda,	5·560	5·560
Water, with trace of muriatic acid,	10·280=99·536	10·280=99·848

The *Brevicite* of Berzelius appears also to belong to this species.

It contains, according to M. Sonden, (Pogg. xxxiii, 112,) Silica 43·88, alumina 28·39, soda 10·32, lime 6·88, magnesia 0·21, water 9·63=99·31.

It comes from Brevig, in Norway, and was named from its locality.

PECTOLITE. ZEOLUS KOBELLI.

Pectolite, *Kobell*, Kastner's Archiv, xiii, 385, xiv, 341.

Spheroidal masses, consisting of divergent fibres radiating from a centre.

H.=4—5. G.=2·69. *Lustre* of the surface of fracture pearly. *Color* grayish. Opaque.

Composition, according to Kobell, (Kastner's Archiv, xiii, 385,) Silica 51·3, lime 33·77, soda 8·26, potash 1·57, water 3·89, alumina and oxyd of iron 0·9=99·69. Fuses to a white transparent glass. According to Frankenheim pectrolite contains no water, and is allied in composition to the Hornblende family.

OBS. Occurs in large masses on Monte Baldo in Southern Tyrol, and at Monzoni in the Fassa-thal. It resembles some radiated varieties of mesotype.

SCOLECITE. ZEOLUS CRISPANS.

Harmophanous Kouphone-Spar, *Haid.* Mesolite. Needlestone. Mesotype (in part.)

Primary form, a right rhombic prism; M : M=91° 35′. *Secondary form :* the primary with the acute lateral edges truncated; also with the terminal edges replaced so as to form a four-sided pyramid at the extremity of the crystal. *Compound crystals :* similar to the annexed figure. The crystals are commonly slender, and occur interlacing one another, or in diverging groups. Also in radiating masses, and sometimes compact.

M. M

H.=5—5·5. G.=2·214, Fuchs and Gehlen—2·27, Brooke. *Lustre* vitreous, inclining to pearly. *Streak* white. *Color* white. Transparent—translucent.

Composition, according to Fuchs and Gehlen, (Schweig. J. xviii, 16,) and Berzelius,

	Faroe.	Staffa.	Mesolite.	Mesolite.
Silica,	46 19	46·75	46·80	47·0
Alumina,	25·88	24·82	26·50	25·9
Lime,	13·86	14·20	9·87	9·8
Water,	13·62	13·64	12·30	12·2
Soda,	0·48	0·39	5·40	5·1
	100·03, F. & G.	99·80, F. & G.	100·87, B.	100·0, F.

In the exterior flame of the blowpipe it becomes opaque, and then curls up like a worm, and finally melts to a very bulky and shining slag. In the interior flame this slag falls down, and is converted into a vesicular and slightly translucent bead. It becomes electric when heated.

It dissolves readily, and forms a thick gelatinous mass, with nitric and muriatic acids before, but not after ignition.

OBS. Scolecite differs from the preceding species in containing lime instead of soda. A variety, consisting of a mixture of scolecite and natrolite, has been separated from this species under the name of *mesolite*. In all its characters, both physical and those obtained by the action of acids, it resembles scolecite.

Scolecite occurs at Tiegerhottue, in the Berufiord, Iceland, where the crystals often exceed two inches in length, and are occasionally a quarter of an inch thick. It has also been met with in amygdaloid, at the Faroe Islands, Staffa; the Vendayah mountains, Hindostan; in Greenland; and at Pargas, Finland. It occurs also in veins in Kilpatrick hills.

The name scolecite is derived from σκώληξ, *a worm*, in allusion to its action before the blowpipe.

DYSCLASITE. ZEOLUS TENAX.

Dysclasite, *Connell.* Okenite, *Kobell*, Kastner's Archiv, xiv, 333.

Structure delicately fibrous; also imperfectly fibrous or composed of a congeries of minute crystals.

H.=4·5—5. G.=2·362 of dysclasite, Connell; 2·28 of Okenite, Kobell. *Lustre* inclining to pearly. *Color* white, with a shade of yellow or blue; often yellow by reflected light, and blue by transmitted; frequently with an opalescent tint. Subtransparent—subtranslucent. Very tough. Exhibits double refraction.

Composition, according to Connell and Kobell,

Silica,	57·69	56·99	55·64
Lime,	26·83	26·35	26·59
Water,	14·71	16·65	17·00
Soda,	0·44	——	——
Protoxyd of manganese,	0·23	——	——
Potash,	0·32	——	} 0·53
Peroxyd of iron,	0·22	——	
Alumina,	——=100·44, C.	——=99·99, K.	——=99·76, K.

When heated in a glass tube, water is obtained. Before the blowpipe, alone, it becomes opaque and white, and fuses on the edges. Effervesces with carbonate of soda, and fuses to a subtransparent glass; with borax it forms a transparent colorless glass.

Pieces thrown into muriatic acid gradually become gelatinous. When pulverized, a jelly is readily formed.

Obs. The *dysclasite* of Connell was brought from the Faroe Islands by Count Varges Redemar, of Copenhagen. It was at first mistaken for mesotype. Okenite occurs, with other minerals of this family, in amygdaloid, in Greenland.

The name Dysclasite is derived from δὺς, *difficultly*, and κλάειν, *to break*.

STELLITE. Zeolus calcareus.

In acicular crystals or fibres, aggregated into radiated or stellar forms.

H.=3·25. G.=2·612, Thomson. *Lustre* silky, shining. *Color* white. Translucent.

Composition, according to Thomson,

Silica 48·465, lime 30·96, magnesia 5·58, alumina 5·301, protoxyd of iron 3·534, water 6·108=99·948.

Before the blowpipe, fuses with effervescence to a white enamel. With a large proportion of borax, it forms a transparent glass; with little borax, a silica skeleton remains. Gelatinizes with muriatic acid.

Obs. Stellite occupies cavities or rifts in greenstone.

It was found by Dr. Thomson near Kylsyth, Scotland, where it forms snow-white stellar aggregations on greenstone.

Stellite from Bergen Hill, N. J. This mineral, according to an analysis by Prof. Beck, (Min. N. Y., p. 343,) approaches Thomson's *stellite* in composition, yet differs in containing less water and but a trace of alumina. Prof. B. obtained Silica 54·60, lime 33·65, magnesia 6·80, oxyd of iron with a little alumina 0·50, water and carbonic acid 3·20.

Mr. A. A. Hayes has analyzed the same mineral with quite a different result, as follows: Silica 55·96, lime 35·12, soda 6·75, potash 0·60, alumina and magnesia 0·08, protoxyd of manganese 0·64, water (hygrometric) 0·16=99·31, (communicated to the author.) The large per centage of soda and the proportion of silica and lime, would seem to ally the species to *Pectolite*, from which, however, it appears to be removed by containing no water.

This mineral occurs in groups, more or less radiating, of needle-form crystals. H.=4—4·5. G.=2·836, Beck. *Lustre* subvitreous. *Color* white; transparent—translucent. It is tough like Dysclasite, and under the pestle may be imperfectly beat out into fibres. It was first found in the rifts of greenstone at Piermont, N. J.; but has since been obtained in much finer specimens at Bergen Hill, N. J. The author has compared specimens of the stellite of Bergen Hill with the foreign Pectolite in Mr. Joseph A. Clay's cabinet at Philadelphia, and finds them closely similar in external characters; moreover,

Frankenheim, in a late article, makes Pectolite an anhydrous mineral, stating that the water varies, and is not an essential ingredient.

EDELFORSITE.

Fibrous or feathery, and massive.

H.=6. (?). G.=2·58. *Lustre* shining. *Color* white or grayish. Transparent.

Composition, Silica 61·85, lime 38·15, with some magnesia, alumina and iron as impurities. Fuses before the blowpipe to a white translucent glass.

OBS. Edelforsite is found at Aedelfors in Smaland, Cziklowa in the Bannat, and at Gjelleback in Norway.

Another compound under the same name, consists of Silica 60·280, alumina 15·416, lime 8·180, peroxyd of iron 4·160, magnesia and oxyd of manganese 0·420, water 11·070=99·526. It has been called the *Aedelfors red zeolite*.

ANALCIME. TESSERA CUBICA.

Hexahedral Kouphone-Spar, *M.* Hexahedral Zeolite, *J.* Cubizit, *W.* Analzim, *L.* Sarcolite.

Primary form, the cube. *Secondary forms:* figs. 14, 15, 16, also fig. 2, and 2 and 5 combined, Pl. I. *Cleavage* parallel to the primary form, but only in traces. Massive varieties have a granular structure.

H.=5—5·5. G.=2·068, Haidinger; 2·278, Thomson. *Lustre* vitreous. *Streak* white. *Color* white; occasionally passing into gray or reddish-white. Transparent—nearly opaque. *Fracture* imperfectly subconchoidal, uneven. Brittle.

Composition, according to H. Rose, (Ann. de Ch. xxv, 192,) Thomson, (Min. i, 338,) and Connell, (Ed. J. of Sci. 1829, 262,)

	Fassa.	Giant's Causeway.	Kilpatrick.
Silica,	55·12	55·60	55·07
Alumina,	22·99	23·00	22·23
Soda,	13·53	14·65	13·71
Water,	8·27=99·91, R.	7·90=101·15, T.	8·22=99·23, C.

Fuses before the blowpipe, on charcoal, without intumescence, to a clear glassy globule. Gelatinizes in muriatic acid. Becomes very slightly electric when heated.

OBS. The varieties of this species, which occur under the last two secondary forms above stated, were separated by the late Dr. Thomson of Naples, as a distinct species, under the name of *Sarcolite*.

The Cyclopean Islands, near Catania, on the Sicilian coast, afford the most perfect pellucid crystals of this species; their form is represented in fig. 14, Pl. I. The same form occurs also in the Tyrol. The form in fig. 16, or the trapezohedron, occurs in Dumbartonshire, the Kilpatrick Hills, Glen Farg. These crystals are generally opaque, and sometimes have a diameter of three or four inches.

Analcime is of frequent occurrence in the Faroe Islands, Iceland, the Vicentine, and elsewhere, in the cavities of amygdaloidal, basaltic, and trap rocks, associated with Prehnite, chabazite, apophyllite, &c. At Arendal in Norway, it occurs in beds of iron ore; and at Andreasberg in the Hartz, in silver mines. The cubo-octahedral variety, or sarcolite, occurs among the ancient lavas of Vesuvius, associated with Wollastonite, hornblende, and several species of the zeolite family.

Nova Scotia affords fine specimens of this mineral. Crystals of the forms in figures 14 and 16, Plate I, occur at Bergen Hill, New Jersey. The gneiss near Yonkers, Westchester Co., N. Y., affords small trapezohedrons. Analcime occurs also at Perry, Maine, with apophyllite, in greenstone.

The name *Analcime* is derived from ἀναλκις, *weak*, in allusion to its weak electric power when heated or rubbed.

LEUCITE. TESSERA TRAPEZOHEDRA.

Trapezoidal Kouphone Spar, *M.* Dodecahedral Zeolite or Leucite, *J.* Amphigène, *H.* White Garnet. Leuzit, *W.*

Primary form, a rhombic dodecahedron, fig. 7, Pl. I. *Secondary form :* fig. 16, a trapezohedron. *Cleavage* very imperfect parallel to the primary planes, (c, fig. 18, Pl. I,) and also to the faces of the cube, (P in fig. 15, Pl. I.) Surface of the crystals even, though seldom shining. Occurs rarely in irregular forms of a granular structure.

H.=5·5—6. G.=2·483—2·49. *Lustre* vitreous. *Streak* white. *Color* ash-gray or smoke-gray, grayish-white. Translucent—nearly opaque. *Fracture* conchoidal. Brittle.

Composition, according to Klaproth, (Beit. ii, 39,) and Arfvedson, (Afhand. vi, 256,)

	Vesuvius.	Albano.		Albano.
Silica,	53·750	54	58·70	56·10
Alumina,	24·625	23	19·95	23·10
Potash,	21·350	22	21·40	21·15
Oxyd of iron,	——	—	0·40	0·95
Lime,	——=99·725, K.	—=99, K.	1·35=101·80, Arf.	——=101·30, Arf.

Infusible before the blowpipe except with borax or carbonate of lime, with which it melts with difficulty to a clear globule. Its powder changes the blue tincture of violets to green. Gives a fine blue with cobalt solution.

OBS. Leucite is abundant in the ancient lavas of the Rieden country, between the Laacher Lee and Andernach, on the Rhine. Vesuvius, however, presents the finest and largest crystallizations. In the vicinity of Rome, at Boghetto to the north, and Albano and Frescati to the south, some of the older lavas are so thickly studded with this mineral, as to appear almost entirely composed of it. The crystals generally present the secondary form, above mentioned.

The Leucitic lava of the neighborhood of Rome has been used for the last 2000 years at least, in the formation of mill-stones. Mill-stones of this rock have lately been discovered in the excavations at Pompeii.

Leucite is derived from λευκος, *white*, in allusion to its color; and because its form is similar to a common variety of the garnet, it has been designated *white garnet.*

SODALITE. TESSERA DODECAHEDRA.

Dodecahedral Kouphone-Spar, *M.*

Primary form, the dodecahedron. *Secondaries*, figures 4 and 5, Plate I. *Cleavage* dodecahedral, more or less distinct. *Imperfect crystallizations*, massive.

H.=6. G.=2·26—2·30. *Lustre* vitreous. *Color* brown, gray, and blue. Transparent—subtranslucent. *Fracture* conchoidal—uneven.

Composition, according to Thomson, (Ann. Phil. i, 104,) Arfwedson, (Schweig. J. xxxiv,)

	Greenland.	Vesuvius.
Silica,	36·00	35·99
Alumina,	32·00	32·59
Soda,	25·00	26·55
Peroxyd of iron,	0·25	——
Muriatic acid,	6·75=100·00, T.	5·30=100·43, A.

The sodalite from Greenland fuses with difficulty before the blowpipe; its sp. gr.=2·29. The sodalite of Vesuvius forms a colorless glassy globule. Gelatinizes with nitric acid.

Obs. Sodalite is met with in granite, trap, basalt, and volcanic rocks.

Sodalite occurs in Greenland; at Vesuvius in white translucent dodecahedral crystals; massive and of a gray color imbedded in trap at the Kaiserstuhl in Brisgau.

HAUYNE. Tessera Hauyi.

Hauyn. Auina, *Monticelli*. Nosean. Nosin. Ittnerite. Spinellane.

Primary form, the dodecahedron. *Cleavage* sometimes distinct. H.=6. G.=2·68—3·33. *Lustre* vitreous. *Color* bright blue, occasionally asparagus-green. Transparent. *Fracture* flat-conchoidal—uneven.

Composition, according to Gmelin and Varrentrapp, (Pogg. xlix, 515,)

	Hauyne.	*Hauyne.*	*Nosean.*		*Ittnerite.*
Silica,	35·48	35·012	35·993		34·016
Alumina,	18·87	27·415	32·566		28·400
Potash,	15·45	——	——		1·565
Soda,	——	9·118	17·837		11·288
Lime,	12·00	12·552	1·115		5·235
Peroxyd of iron,	1·16	iron 0·172	iron 0·041		0·616
Chlorine,	——	0·581	0·653	Gypsum and salt,	6·509
Sulphur,	——	0·239	——		——
Sulphuric acid,	12·39	12·602	9·170	Water and sulph. hyd.	10·759
Water,	1·20	0·619	1·847		
	96·55, G.	98·340, V.	99·222, V.		98·388, G.

Hauyne fuses slowly before the blowpipe to an opaque white mass. With borax it effervesces and forms a clear vitreous globule, which becomes yellow on cooling. Gelatinizes with muriatic acid.

Obs. Hauyne occurs in the Vesuvian lavas; also in the vicinity of Rome, in basalt at Nieder-Mendig near Andernach on the Rhine, and at the Laacher Lee (spinellan or nosean variety) near Andernach, in loose blocks consisting largely of glassy feldspar with some black mica, magnetic iron, and occasionally zircon; the feldspar is granular, and contains cavities of crystals, among which the nosean occurs in grains a line in length.

LAPIS LAZULI. Tessera ultramarina.

Lasurstein. Ultramarine.

Primary form, the dodecahedron. *Cleavage* dodecahedral, imperfect. *Imperfect crystallizations*, massive.

H.=5·5. G.=2·5—2·9. *Lustre* vitreous. *Color* rich Berlin or azure-blue. Translucent—opaque. *Fracture* uneven.

Composition, according to Gmelin, Clement and Desormes, and Varrentrapp, (Pogg. xlix, 519,)

Silica,	49·0	35·8		45·50
Alumina,	11·0	34·8		31·76
Soda,	8·0	23·2		9·09
Potash,		——		——
Lime,	16·0	——		3·52
Peroxyd of iron,	4·0	——	Iron,	0·86
Sulphuric acid,	2·0	——		5·89
Sulphur,	——	3·1		0·95
Carbonate of lime,	——	3·1	Chlorine,	0·42
Water,	——=90·0, G.	——=100, C. & D.		0·12=98·11, V.

Lapis Lazuli fuses to a white translucent or opaque glass, and if calcined and reduced to powder, loses its color in acids. The coloring matter in the Lapis Lazuli is a sulphate—probably of iron.

Obs. Lapis Lazuli is usually found in granite or crystalline limestones. It is brought from Persia, China, Siberia, and Bucharia; the specimens often contain scales of mica and disseminated pyrites. On the banks of the Indus, it occurs disseminated in a grayish limestone.

The richly colored varieties of Lapis Lazuli are highly esteemed for costly vases and ornamental furniture. Magnificent slabs are contained in some of the Italian cathedrals. It is also employed in the manufacture of mosaics; and when powdered constitutes the rich and durable paint called *Ultramarine*.

An artificial ultramarine used in painting porcelain at Meissner contains, according to Varrentrapp,

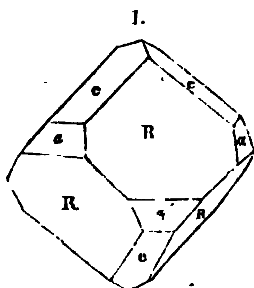
Silica 45·604, alumina 23·304, soda 21·476, potash 1·752, lime 0·021, sulphuric acid 3·830, sulphur 1·685, iron 1·063, chlorine, a small quantity undetermined=98·735. This artificial ultramine equals the native in brilliancy of color and permanency, and is now extensively used in the arts.

CHABAZITE. CHABAZIUS RHOMBOHEDRUS.

Rhombohedral Kouphone-Spar, *M.* Rhombohedral Zeolite or Chabazite, *J.* Chabasie, *P. L. and H.* Schabasit, *W.* Chabasin, *Haid.* Levyne, *Brewster.* Mesolin. Macrotypous Kouphone-Spar, *M.* Gmelinite, *Brewster.* Hexagonal Kouphone-Spar, *Haid.* Hydrolite, De Drée. Sarcolite, *Vauq.* Phacolite, *Breit.* Ledererite, *Jackson.* Acadiolite, *Alger and Jackson.*

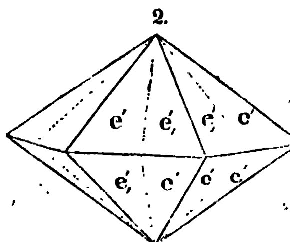
Primary form, an obtuse rhombohedron, R : R=94° 46′. *Secondary form*, figure 1. R : e=137° 23′, e : e=125° 18′; R : a =126° 26½′. R : e (over *a*)=83° 31′, e′ : e′ (over basal edge, figure 2)=71° 48′, e′ : e′ (over a terminal edge)=145° 54′. The inclination of R on *a″* (over *a*) in Gmelinite (figure 3) is stated by Brewster at 83° 36′, by Rose at 80° 54′.

1.



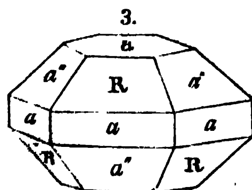
Chabazite.

2.



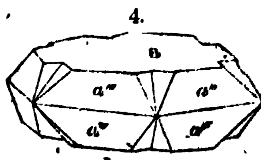
Chabazite, Phacolite.

3.



Gmelinite.

4.



Levyne.

Compound crystals: composition parallel with a. a‴ : a‴ (over the base, figure 4, Levyne)=125° 12′: also in twins compounded parallel with R. Plane a often curved or striated: and *a* in figure

3 horizontally striated; the edges of the pyramids (figures 2 and 3) often a series of striæ. *Cleavage* rhombohedral, rather indistinct.

H.=4—4·5. G.=2·08—2·17, (var. chabazite,) Tamnau; 2·06, (var. Gmelinite,) Rammelsberg; 2·161, (Levyne,) Thomson; 2·169, (Ledererite,) Hayes. *Lustre* vitreous. *Color* white, flesh-red. Transparent—translucent. *Fracture* uneven. Brittle.

Composition, according to Arfvedson, Rammelsberg, (Pogg. xlix, 211,) Thomson, (Min. i, 336,) Connell, (Jameson's J. No. 48, p. 360,) and Hayes, (Sill. Jour. xxv, 78,)

	Chabazite, Faroe.	*Chabazite.*	*Levyne.*	*Gmelinite,* Antrim.	*Gmelinite.*		*Ledererite.*
Silica,	48·38	48·363	48·750	48·56	46·564		49·47
Alumina,	19·28	18·615	20·333	18·05	20·186		21·48
Lime,	8·70	9·731	8·833	5·13	3·895		11·48
Soda,	——	0·255	3·333	3·85	7·094		3·94
Potash,	2·50	2·565	*trace*	0·39	1·873	Phos. acid,	3·48
Perox. of iron,	——	——	Mag. 0·770	0·11	——		0·14
Water,	21·14	Loss, 20·471	20·000	21·66	20·412		8·58
	100·00, A.	100·000, R.	98·019, T.	98·75, C.	100·024, R.		98·57, H.

Intumesce and whiten before the blowpipe. The variety *Gmelinite* forms a jelly with muriatic acid. Opaque crystals become translucent in oils.

OBS. The identity of Levyne and Gmelinite with Chabazite has lately been shown, in a very complete article on this subject, by Tamnau, in Leonhard and Bronn's Neues Jahrb. f. Min. 1836, 633; see also an article by Rammelsberg, in Poggendorf's Annalen, xlix, (1840,) 211, and the Chemical Mineralogy of this author, in which he expresses his doubts with regard to the late conclusions of Connell. The crystals of Levyne afford faces of the three rhombohedrons 106° 4′, 70° 7′, and 79° 29′, of which the last was taken for the primary; but all may be secondaries to chabazite. Gmelinite included crystals presenting the form of double six-sided pyramids, (figs. 2 and 3.) The Ledererite of Jackson, from Cape Blomidon, presents the same form as Gmelinite: as Rammelsberg states, it has the same chemical formula as Chabazite, excepting one third the amount of water. *Phacolite* also has nearly the same form as Gmelinite, (figure 2,) and according to an analysis by Anderson, (Berz. Jahresb. xxii, and Jameson's Jour. No. 67, p. 23, 1843,) consists of Silica 45·628, alumina 19·480, peroxyd of iron 0·431, lime 13·304, magnesia 0·143, potash 1·314, soda 1·684, water 17·976=99·962. R : R for Phacolite is given at 94° by Breithaupt.

Chabazite occurs mostly in trap, basalt, or amygdaloid, and occasionally in gneiss, syenite, and mica slate.

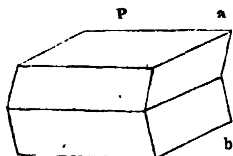
Fine crystallizations occur at the Faroe Islands, Greenland, and Iceland, associated with chlorite and stilbite; also at Aussig in Bohemia, in a kind of greenstone, (the *graustein* of Werner,) also at the Giant's Causeway, Kilmalcolm, Renfrewshire, Isle of Skye, &c. In Nova Scotia it occurs in fine crystals, often highly modified, of a wine-yellow or flesh-red color, and is associated with Heulandite, analcime, and calcareous spar. The variety *Levyne* occurs in trap at the little Deer Park of Glenarm, Scotland; also at Skagastrand, Iceland; at Dalsnypen, Faroe, with chabazite, analcime, and Heulandite; at Godhavn, Disco Island, Greenland, and occasionally in large crystals at Hartfield Moss in Renfrewshire. *Gmelinite* is found at Montecchio Maggiore and at Cartel, in the Vincentine, in the cavities of amygdaloidal rocks; also in the county of Antrim, at the Deer Park of Glenarm, of a white color, and at the Island Magee near Larne, of a pale flesh-red. Ledererite was obtained by Jackson and Alger at Cape Blomidon, Nova Scotia, where it occurs in basalt associated with stilbite, mesotype, and analcime: the crystals are usually implanted in the analcime or stilbite. Phacolite occurs at Leypa in Bohemia.

Chabazite occurs both massive and crystallized at the Paugatuck stone-quarry, Stonington, Conn., associated with scapolite, sphene, and apatite; also of a yellowish-red color in North Killingworth, on the Essex turnpike; at Hadlyme, Conn., on gneiss; in syenite at Charlestown, Mass.; also at Chester, Mass.; at Bergen Hill, N. J., in small crystals, sometimes having the edges and angles rounded; and in greenstone at Piermont, N. Y.

Acadiolite. This name has been applied to a red chabazite from Nova Scotia, procured there by Jackson and Alger. It has the physical properties and crystallization of chabazite. G.=2·02. Dr. Thomson obtained for its composition, Silica 52·4, alumina 12·4,

peroxyd of iron 2·4, lime 11·6, water 21·6=100·4, (Phil. Mag. 1843, p. 192.) The coloring matter which appears to be oxyd of iron, is almost wanting in some specimens, and in one the author observed a tesselated arrangement of it, the angles being nearly colorless. Another analysis is required before this mineral is separated from chabazite.

HAYDENITE. Chabazius monoclinatus.



Primary form, an oblique rhombic prism. M : M=98° 22′, P : M=96° 5′, (Levy.) *Cleavage*: lateral and basal, perfect; the latter little the most so. Twin crystals compounded parallel with P, as in the annexed figure.

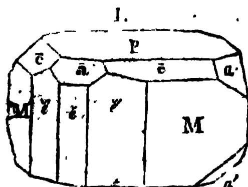
H.=3. *Lustre* vitreous; bright. *Color* brownish-, greenish-, or wine-yellow. Translucent—transparent. Brittle.

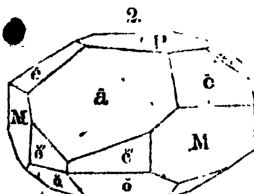
Obs. Haydenite was first described and named by Cleaveland. It has since been considered chabazite, and was lately restored to its place as a species by Levy. It occurs coating hornblendic gneiss, in fissures at Jones's Falls, a mile and a half from Baltimore. The crystals seldom exceed a line in length, and are nearly rhombs in shape. They are usually coated with a brownish-green hydrate of iron, which is easily separated, and leaves the surface smooth and bright. Occasionally crystals are met with, consisting wholly of this hydrate of iron. The Haydenite is associated with Heulandite in minute crystals.

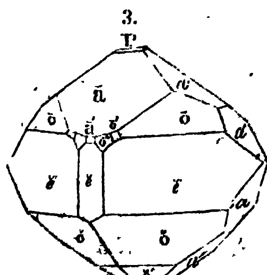
DATHOLITE. Datholus obliquus.

Prismatic Dystome-Spar, *M.* Borate of Lime, *P.* Borosilicate of Lime, *Thom.* Datholith, *W.* Esmarkite, *Haus.* Datolite. Humboldtite, *Levy.* Botryolite. Chaux Boratée Siliceuse, *H.*

Primary form, an acute oblique rhombic prism; M : M=77° 30′. *Secondary forms*,







Roaring Brook, Ct.

P : ĕ=91° 41′, ĕ′ : ĕ′=116° 9′, ĕ : ĕ′=148° 4½′, M : ĕ=128° 45′, M : ĕ′=150° 40½′. *Cleavage* parallel to M and also ĕ, or the shorter diagonal, but not distinct. *Imperfect crystallizations:* botryoidal and globular shapes, having a columnar structure; also divergent and radiating forms; also granular.

H.=5—5·5. G.=2·989, (from Arendal,) Haidinger. *Lustre* vitreous, often inclining to resinous on the surface of fracture; sometimes also pearly. *Streak* white. *Color* white; sometimes inclining to gray, green, yellow, or red; rarely of a dirty olive-green or honey-yellow tinge. Translucent. *Fracture* uneven, subconchoidal. Brittle.

Composition, according to Stromeyer, (Pogg xii, 157,) Rammelsberg, (Pogg xlvii, 175,) and Klaproth, (Beit iv, 356,)

	Datholite, Andreasberg		*Datholite* Arendal		*Botryolite*
Silica,	37·36	38·477	37·648	36·5	36·390
Lime,	35·67	35·640	35·407	35·5	34·270
Boracic acid,	21·26	20·315	21·240	24·0	18·342
Water,	5·71	5·568	5·705	4·0	10·244
	100·00, S	100·000, R	100·000, R	100·0, K	99·246, R

The third by Rammelsberg contains also 0·774 of alumina and peroxyd of iron

Botryolite appears to differ in containing twice as much water as datholite

Datholite (including its varieties) becomes friable in the flame of a candle Before the blowpipe it becomes opaque, intumesces, and melts to a glassy globule It dissolves readily and gelatinizes with nitric acid

Obs Datholite is found in amygdaloid and gneiss, sometimes also in beds of iron ore in primitive rocks In the latter situation both varieties are found at Arendal in Norway The variety *Humboldtite*, which was instituted as a distinct species by Levy, occurs in agate balls at the Seisen Alp, in the Tyrol Datholite is met with also in the valley of Glen Farg, Perthshire

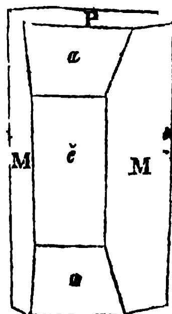
The States of New Jersey and Connecticut afford the principal American localities of this species, at each of which it occurs in amygdaloid

Datholite occurs crystallized and massive in trap, at the Rocky Hill quarry Hartford, Conn, in the northeast part of Southington near Mr Hamlen's, in amygdaloid, both in crystals, fibrous and massive; also in Berlin near Kensington, in the northwest part of Meriden and at Middlefield Falls, Conn The best specimens in Connecticut come from Roaring Brook, 14 miles from New Haven, where the crystals are highly modified and sometimes are half an inch long and nearly pellucid Bergen Hill, N J, has afforded fine specimens, and Patterson, N J, specimens of less interest Occurs sparingly at Piermont, New York

PREHNITE. CLASISTYLUS ACROTOMUS

Axotomous Triphane-Spar, *M* Prismatic Prehnite *J* Koupholite Edelith Chiltonite, *Emmons*

Primary form, a right rhombic prism; M : M=99° 56′. *Secondary form*, M : $\check{e}$=130° 2′. P : *a*=106° 30′. *Cleavage:* basal, distinct. Tabular crystals often unite by P, so as to produce what appears to be a single crystal broken in several places, and somewhat rounded at its extremities. *Imperfect crystallizations:* reniform, globular, and stalactitic shapes, with a crystalline surface, and imperfectly columnar or lamellar, strongly coherent structure; also granular and sometimes impalpable.



H.=6—6·5. G.=2·8—2·953. *Lustre* vitreous, except on P, whose lustre is pearly, especially if obtained by cleavage. *Streak* white. *Color* various shades of green, passing into white and gray. Subtransparent ... *Fracture* uneven. Somewhat brittle.

Composition, according to Klaproth, (Ann de Ch i, 208,) Gehlen, (Schweig J iii, 182,) Thomson and Lehunt (Thom Min i 275,)

	A foliated var.	Fibrous var.	Fib. light green.	White var. Edinb.
Silica,	43·80	43·00	43·60	43·048
Alumina,	30·33	23·25	23·00	23·840
Lime,	18·33	26·00	22·33	26·164
Protox. iron,	5·66	2·00	2·00	0·640
Protox. mang,	—	0·25	—	0·416
Potash and soda,	—	—	—	1·028
Water,	1·16	4·00	6·40	4·600
	99·28, K.	98·50, G.	97·33, T.	99·736, L.

Before the blowpipe, on charcoal, it froths and melts to a slag of a light-green color. With borax it forms a transparent bead. In dilute muriatic acid, it dissolves slowly, without gelatinizing, and leaves behind a flaky residue. When heated, it exhibits electric polarity.

Obs. Prehnite was first found at the Cape of Good Hope by Colonel Prehn, after whom it was named by Werner. It has since been discovered at numerous places in Europe, in Asia, and America, in granite, gneiss, and trap rocks.

At St. Christophe, in Dauphiny, it is associated with axinite and epidote; it also occurs in the Fassa valley, Tyrol, in Saltzburg, at Friskie Hall and Campsie in Dumbartonshire, and at Hartfield Moss; in Renfrewshire, in veins traversing trap, associated with analcime and Thomsonite; also at Corstorphine Hill, the Castle and Salisbury Crag, near Edinburgh.

In the United States, finely crystallized specimens have been obtained at Farmington, Woodbury, and Middletown, Conn., and West Springfield, Mass., and Patterson and Bergen Hill, N. J. It occurs in small quantities in gneiss, at Bellows' Falls, Vt., and in Syenite, at Charlestown, Mass., Milk Row quarry, often in minute tabular crystals, associated with chabazite; also at Palmer (Three River) and Turner's Falls on the Connecticut, Mass., in greenstone, and at Perry, above Loring's Cove, Maine.

Handsome polished slabs of this mineral have been cut from large masses brought from China.

HERSCHELITE.

Levy, Ann. of Philosophy, 2d ser. x, 361.

Primary form, a hexagonal prism. Secondary, a flat hexagonal table, with replaced terminal edges; P : e about 132°. *Cleavage* perfect, and easily obtained parallel with P.

H.=4·5. G.=2·11. *Color* white. Translucent—opaque.

According to the trials of Dr. Wollaston, it contains Silica, alumina, and potash.

Obs. It occurs in the cavities of trap at Aci Reale, near Catania, in Sicily, associated with Phillipsite. The crystals are sometimes isolated, but generally aggregated in a manner similar to those of Prehnite.

This species was named by Levy in honor of Sir Wm. Herschel.

NEPHRITE. Nephrus amorphus.

Uncleavable Nephrite-Spar, *Haid.* Common Jade, *P.* Jade Nephritique, *H.* Talcum Nephriticum, *Linn, Wern.* Beilstein.

Massive; fine granular, or impalpable.

H.=6·5—7·5. G.=2·932—3·024. *Lustre* vitreous. *Streak* white. *Color* leek-green, passing into blue, gray, and white. Translucent—subtranslucent. *Fracture* coarse, splintery. Very tough.

Composition, according to Kastner and Bowen,

		From Smithfield, R. I.
Silica,	50·50	41·688
Magnesia,	31·00	34·631
Alumina,	10·00	0·562
Ox. iron,	5·50	1·747
Ox. chrome,	0·05	Lime, 4·250
Water,	2·75=99·80, K.	13·417=96·295, B.

Infusible, alone, before the blowpipe, but becomes white; with borax it forms a clear glass. Some specimens melt with difficulty to a grayish mass.

Obs. Jade was originally brought from China and Egypt. A fine sky-blue variety occurs in the primitive limestone of Smithfield, R. I., and a greenish and reddish-gray variety in the same species of rock at Easton, Penn., and Stoneham, Mass.

* The name *Nephrite* is derived from νεφρος, a *kidney;* it was supposed to be a cure for diseases of the kidney.

SAUSSURITE. Nephrus peritomus.

Prismatic Nephrite Spar, *Haid.* Jade Tenace, Feldspath Tenace, *H.* Lemanit. Magerer Nephrit.

Imperfectly crystallized: cleavage in two directions parallel to the lateral faces of a rhombic prism of 124° nearly. Composition often granular, impalpable; strongly coherent.

H.=5·5—6. G.=3·256, a granular variety from Piedmont; 3·342, a compact variety from the Pays de Vaud. *Lustre* pearly, inclining to vitreous upon the faces of cleavage; also resinous in some specimens, particularly the massive. *Streak* white. *Color* white, passing into greenish-white, mountain-green, or ash-gray. *Fracture* uneven, splintery. Extremely tough.

Composition, according to Klaproth (Beit. iv, 278) and Saussure, (J. des Mines, xix, p. 217,)

Silica,	49·00	44·00
Alumina,	24·00	30·00
Lime,	10·50	4·00
Magnesia,	3·75	Potash, 0·25
Peroxyd of iron,	6·50	12·50
Soda,	5·50	6·00
Ox. manganese,	——	0·05
Loss,	0·75=100, K.	3·20=100, S.

Before the blowpipe it fuses with great difficulty to a greenish-gray glass. Not acted upon by acids.

Obs. Saussurite occurs in primitive regions, and with hornblende and augite constitutes the rocks called gabbro and euphotide. It was first found on the borders of the lake of Geneva, by Saussure Senior, whose name it bears. It also occurs at Monte Rosa and its vicinity, in Corsica, in Greenland, at Madras, and elsewhere, as a constituent of the above rocks.

BOLTONITE.

Silicate of Magnesia, *Thom.* Boltonite, *Shepard.*

Occurs massive; structure coarsely granular. *Cleavage* pretty distinct in one direction; in two others oblique to the first, indistinct, but indicating an oblique rhomboidal prism as the primary form.

H.=5—6. G.=2·8—2·9. *Lustre* vitreous. *Streak* white. *Color*

bluish-gray, yellowish-gray, wax-yellow, yellowish-white. The darker colors turn yellow on exposure. Transparent—translucent.

Composition, according to Thomson, Silica 56·64, magnesia 36·52, alumina 6·07, protoxyd of iron 2·46=101·69.

Before the blowpipe alone, it is bleached and rendered transparent, but does not fuse. With borax it forms a transparent glass.

OBS. Boltonite is disseminated through the white limestone at Bolton, Mass., and has also been observed in the neighboring quarries of Boxborough and Littleton: also in Dolomite at Ridgefield, Ct., in bluish-gray grains, and at Hill's quarry, Reading, Ct., of a pale straw-yellow color.

GLAUCOLITE.

Bergmann, Edin. New Phil. Jour. iii, 385, 1827.

Massive; traces of cleavage parallel with the faces of a rhombic prism of about 143° 30′, according to Brooke.

H.=5. G.=2·72—2·9. *Lustre* vitreous. *Color* lavender-blue passing into green. *Fracture* splintery.

Composition, according to Bergmann, (Pogg. 1827.)

Silica,	50·583
Alumina,	27·600
Lime,	10·266
Magnesia,	3·733
Potash,	1·266
Soda,	2·966=96·414,

with 0·1 of iron and 0·87 of manganese, which are supposed to be accidental impurities.

Before the blowpipe it whitens and fuses only on the edges; with borax or salt of phosphorus, it is readily soluble

OBS. This species was observed by Menge near Lake Baikal in Siberia, imbedded in compact feldspar and granular limestone. Frankenheim has lately suggested that it is nothing but *Labradorite*.

TURQUOIS. LAZULUS AMORPHUS.

Uncleavable Azure-Spar, *M.* Calaite. Mineral Turquois. Agaphite. Johnite. Kalait and Türkis *of the Germans*. Birousa *of the Persians*. Callais (probably) of *Pliny*.

In reniform masses. *Cleavage* none.

H.=6. G.=2·83—3·00. *Lustre* somewhat waxy, internally dull. *Streak* white. *Color* a peculiar bluish-green. Feebly subtranslucent—opaque. *Fracture* small conchoidal.

Composition, according to John, (Ann. des Mines, 2d ser. iii, 231,)

Phosphoric acid,	30·90
Alumina,	44·50
Oxyd of Copper,	3·75
Protoxyd of iron,	1·80
Water,	19·00=99·95

Berzelius obtained in his analysis, Phosphate of alumina, phosphate of lime, silica, oxyd of iron, and copper.

Becomes brown in the reducing flame of the blowpipe, and colors it green, but is infusible; it fuses readily, however, with borax or salt of phosphorus. Insoluble in muriatic acid, and may thus be distinguished from other species called by the name of Turquois.

OBS. This species occurs only in a mountainous district in Persia, not far from Nichabour. According to Agaphi, the only naturalist who has visited the locality, turquois occurs only in veins which traverse the mountains in all directions.

It receives a fine polish, and is valued for ornamental purposes; and when finely colored, is highly esteemed as a gem. The Persian king is said to retain for his own use all the larger and finely tinted specimens.

Pliny remarks concerning the Callais, which appears to be identical with the turquois, that it occurred of a pale-green (e viridi pallens) color, and that its finest color was emerald. He states, that its form was usually round, and also the fable that it was found in Asia projecting from the surface of inaccessible rocks, whence it was obtained by means of slings.

LAZULITE. LAZULUS RHOMBICUS.

Prismatic Azure-Spar, *M.* Azurite, *P.* Azurestone. Hydrousdiphosphate of Alumina and Magnesia, *Thom.* Blue Spar. Prismatoidal Azure-Spar, *M.* Feldspath bleu, *H.* Vorаulite. Blauspath.



Primary form, a right rhombic prism; M : M=91° 30′. *Secondary form*: M : ē=135° 45′, M : e=158° 10′, M : e′=140° 46′, *a* : *a*=120° 40′, *a* : *a′*=150°, ē : a=150° 45′, a : e=138° 45′. *Cleavage* indistinct parallel with M. Occurs also granularly massive; particles strongly coherent.

H.=5—6. G.=3·057, Fuchs. *Lustre* vitreous. *Streak* white. *Color* various shades of azure-blue; commonly a fine deep blue, viewed in one direction, and a pale greenish-blue, at right angles with this direction. Subtranslucent—opaque. *Fracture* uneven. Brittle.

Composition, according to Fuchs, (Schweig. J. xxiv, 373,) and Brandes, (do. xxx, 385,)

Phosphoric acid,	41·81	43·32
Alumina,	35·73	34·50
Magnesia,	9·34	13·56
Silica,	2·10	6·50
Protoxyd of iron,	2·64	0·80
Water,	6·06=97·68	0·50
		Lime, 0·42=99·60, B.

Intumesces slightly before the blowpipe, and assumes at a high heat a glassy appearance, but does not fuse. With borax, it yields a clear colorless globule.

OBS. It occurs both massive and crystallized in narrow veins, traversing clay slate, in the torrent beds of Schlamming and Rädelgraben, near Werfen in Saltzburg. It is also found near Vorau in Styria, whence it has been called Vorauhte.

The name Lazulite is derived from an Arabic word *azul*, meaning *heaven*, and alludes to the color of the mineral.

NEPHELINE. SPATUM HEXAGONUM.

Rhombohedral feldspar, *M.* Rhomboidal feldspar, *J.* Sommite, *P.* Davina and Nefelina. *Monticelli.* Davyne. Carolinite, *Mont.* Beudantin, Beudantite, *Mont.* Elæolite. Fettstein, *W.* Pierre Grasse. Lythrodes. Sodalte. Cancrinite, *G. Rose*, Pogg. xlvii, 379.

Primary form, a hexagonal prism. *Secondary*, figure 125, Plate II. M : *e*=150°, P : e=134° 3′, (Nepheline,) Phillips. P : e′=154° 27′, (Davyne,) and M : e′=115° 33′, Haidinger. *Cleavage*, prismatic and basal, imperfect. Also thin columnar and massive.

H.=5·5—6. G.=2·5—2·64, Nepheline and Elæolite; 2·429, Davyne; 2·453, Cancrinite. *Lustre* vitreous—greasy; little opalescent in some varieties. *Color* white or yellowish, dark green, greenish or bluish-gray, brownish and brick-red. Transparent—opaque. *Fracture* subconchoidal.

Composition, according to Gmelin and Scheerer, (Pogg. xlix, 359,) Monticelli and Covelli, and G. Rose, (Pogg. xlvii, 379,)

	Nepheline.	*Nepheline.*	White Elæolite.	Green do.	Davyne.	Cancrinite.
Silica,	43·36	44·29	44·30	45·31	42·91	40·59
Alumina,	33·49	33·04	33·25	32·63	33·28	28·29
Perox. iron,	1·50	0·39	0·82	0·45	3·11	——
Lime,	0·90	1·82	0·32	0·33	12·02	7·06
Soda,	13·36	14·93	16·02	15·95	——	17·38
Potash,	7·13	4·72	5·82	5·45	Ox. mang. 1·25	Potash, 0·57
Water,	1·39	0·21	Mag. 0·07	0·60	7·43	Carb. ac. 6·11
	101·13, G.	99·40. S.	100·60, S.	100·72, S.	100·00, M.&C.	100·00, R.

Breithaupt has offered reasons for believing (Pogg. liii, 145, 1841) that the analysis of *Davyne* is not correct, and appears to show that the *Cancrinite* of Rose is identical with it. The crystallization of Davyne is the same as that of Nepheline and the analysis of Cancrinite shows no great discrepancy in composition. The plane replacing the terminal edge, is different in Davyne and Nepheline, but they are derivable one from the other. *Elæolite*, which Scheerer has lately proved to be identical with Nepheline, (Pogg. xlix, 359, 1840,) occurs in cleavable masses, translucent to opaque, of grayish-green, brownish, and white colors, and having a greasy lustre.

Nepheline becomes rounded on the edges before the blowpipe. In nitric acid fragments lose their transparency and become clouded. Davyne fuses readily to a white blebby glass. With salt of phosphorus, Cancrinite fuses with intumescence, and with the separation of a skeleton of silica to a clear glass, which with more of the flux becomes opaline on cooling. Elæolite and Davyne gelatinize readily in nitric acid.

Obs. Nepheline occurs in crystals in the older lavas of Vesuvius, with mica, idocrase, &c.; also at Capo di Bove near Rome, and in the Clinkstone at Katzenbuckel near Heidelberg. Elæolite comes from Brevig, Stauern, and Fredericksvärn, Norway, where it is found imbedded in Zircon-syenite: also from Ilmengebirge in Siberia, along with white feldspar, brown hexagonal mica, zircon, pyrochlore, &c. Davyne is met with among the Vesuvian lavas, in long translucent or transparent six- and twelve-sided prisms. Cancrinite occurs at the Ilmen mountains, Ural, associated with sodalite, apatite, fluor, zircon, and elæolite. The name Nepheline is derived from νεφέλη, *a cloud*, and alludes to the action in acids; and elæolite is from ἔλαιον, *oil*, in allusion to its greasy lustre. Davyne was named in honor of Sir Humphry Davy, and Cancrinite after Cancrin, one of the Russian Ministers of Finance.

Gieseckite. Tamnau proposes to unite Gieseckite with Nepheline and Elæolite, with which it agrees in most of its characters. It occurs in hexagonal prisms, sometimes with the terminal edges replaced. Lustre greasy. H.=2·5—3: fresh specimens are said by Tamnau to have the hardness of Elæolite. G.=2·78, Leonhard. Color grayish-green and dirty olive-green. Subtranslucent—opaque. Fracture uneven and splintery.

Composition, according to Stromeyer, (Gilbert's Ann. lxiii, 272,) Silica 46·07, alumina 33·82, protoxyd of iron 3·35, potash 6·20, magnesia 1·20, protoxyd of manganese 1·15, water 4·88.

It was brought from the district of Julianenhaab in Greenland, by the late Sir Charles Giesecké, where it occurs in porphyry.

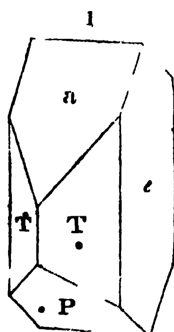
Indianite is a lime-Nepheline, according to Beudant. We have associated it with anorthite.

FELDSPAR. Spatum orthotomum.

Orthotomous Feldspar, *M.* Prismatic Feldspar, *J.* Felspar. Ice Spar. Orthose, Orthoclase. Adularia, Murchisonite, Leelite, Amausite, Amazonstone, Sunadin, Moonstone, Napoleonite, Necronite. Feldstein, *Haus.* Feldspath, *K.* Eisspath, *W.* Mikrolin, *Breit.* Erythrite, Peristerite, and Perthite of *Thomson*.

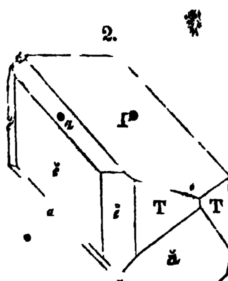
Primary form, an oblique rhombic prism; T : T=118° 49′, P : T=67° 15′. ***Secondary forms:*** according to Mohs,

1

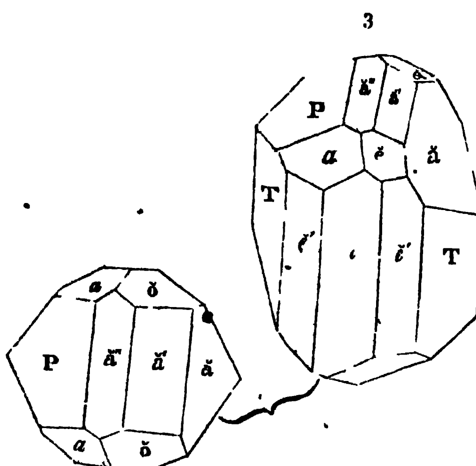


Rossie, N Y.

2.

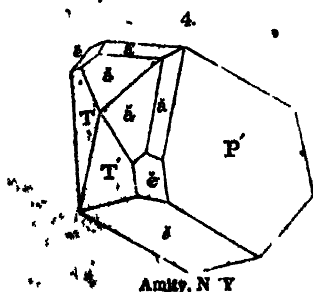


3



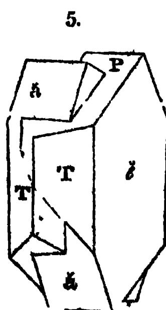
P : ă=99° 37′ or 80° 23′, P : ă′=129° 40, P : ă″=145° 47′. P : *a* =135° 3½′, *ĕ* : *a*=134° 46½′, T : *ĕ*=120° 40′, *ĭ′* : *ĭ′* (over *e*)=121° 21′. *Cleavage* parallel with P perfect; with *ĕ*, or the shorter diagonal, less distinct. *Compound crystals:*

4.

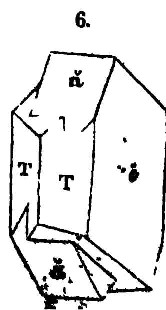


Amity, N Y

5.



6.



Carlsbad

in figs. 5 and 6, composition is of the *second kind*, and has taken place parallel with *i*. In fig. 4 it is of the *third kind*, and has been effected parallel to a plane on a lateral angle.

Massive varieties have usually a granular structure of different degrees of fineness; also sometimes a lamellar composition.

H.=6. G.=2·394—2·581, Rose. *Lustre* vitreous; sometimes inclining to pearly upon the face of perfect cleavage. *Streak* white, or grayish-white. *Color* white; often gray, reddish-white, flesh-red, greenish-white, green. Transparent—translucent. *Fracture* conchoidal to uneven.

Composition, according to Berthier, (Ann. des Mines, vii, 239,) and Abich, (Pogg. l, 125,)

	Adularia	*Feldspar* fr. Baveno.	*Soda-feldspar* fr. Pantellaria.	*Glassy feldspar* fr. Sothma.
Silica,	64·20	65·77	68·23	67·87
Alumina,	18·40	18·57	18·30	15·72
Perox. iron,	——	trace	1·01	2·41
Lime,	——	0·34	1·26	3·16
Magnesia,	——	0·05	0·51	1·40
Potash,	16·95	14·02	2·53	6·68
Soda,	——=99·55, B.	1·25=100, A.	7·99=99·83, A.	2·86=100·10, A.

Abich finds one or more per cent. of soda in all the feldspars analyzed by him. Feldspar fuses with difficulty before the blowpipe, and only on the edges. With borax it forms slowly a transparent glass, and with soda a vesicular glass. Not acted upon by the acids.

OBS. Difference of color and lustre has given rise to distinct names for several of the varieties of this species.

Common feldspar includes the subtranslucent varieties, the common constituent of granites.

Necronite is a variety of feldspar, which gives off a fetid odor when struck.

Adularia is a transparent or translucent variety, found in granitic rocks. The crystals are often large, and occur of great perfection in the high districts of Savoy; the name is derived from Adula, one of the highest peaks of St. Gothard. The *Valencianite* of Breithaupt is a variety of Adularia.

Moonstone is a variety of Adularia, presenting, when polished, chatoyant or pearly reflections. *Sunstone* is a similar variety containing minute scales of mica disseminated through it. The opalescence is seen only in the direction of a plane replacing the edge T : T somewhat obliquely.

Glassy feldspar is a transparent variety found in trachytic and volcanic rocks, having a perfect vitreous lustre. The name *ice spar* is sometimes given to a similar variety found in the Vesuvian lavas.

Other varieties are the *Murchisonite* of Levy, which is a yellowish-gray variety from Dawlish and Arran; the *Leelite* of Dr. Clarke, (the *Hellefinta* of the Swedes,) which occurs at Gryphyttan in Sweden, with a peculiar waxy lustre, and a deep flesh-red color; and the *Variolite*, a dark green variety, containing lighter globular particles, from Drac river in France. *Kaolin* is a term applied to a clay resulting from the decomposition of feldspar. In the formation of Kaolin, (called also Porcelain earth,) the principal change consists in the removal of the alkali of the feldspar, with part of the silica, and the addition of water. The following are analyses by Berthier, Forchhammer, and Fuchs:

	Schneeberg.	Meissen.	Meissen.	Passau.
Silica,	43·6	58·6	46·46	[illegible]
Alumina,	37·7	34·6	36·37	35·93
Peroxide of iron,	1·5	Magnesia, 1·8	1·22	1·00
Potash,	——	2·4	Carb. lime, 1·47	Carb. lime, [illegible]
Water,	12·6	——	13·61	18·50
	95·4, B.	98·9, B.	99·13, Fr.	99·96, Fs.

The *Microlin* of Breithaupt is a variety of this species, (Pogg. xlvii, 196) The *Erythrite* of Thomson (Phil. Mag. xxii, 188, 1843) is a flesh colored feldspar containing 3 per cent. of magnesia, found in amygdaloid. The *Peristerite* of Thomson (Phil. Mag. xxii, 189) appears to be an impure iridescent feldspar from Perth in Upper Canada. The *Perthite* of the same author (Phil. Mag. xxii, 189) is another doubtful species allied to feldspar, which it closely resembles in external characters.

Fine crystalline feldspar is found at Carlsbad and Elbogen in Bohemia. The twin crystals, represented in figs. 5, 6, are very abundant at the former place, where they occur from two to four inches in length, scattered over the fields, from the decomposition of the granite of the region. Ekatherinenburg in Siberia, Warmbrunn in Silesia, Arendal in Norway, Baveno in Piedmont, Land's End, &c., are among the interesting localities of this species. At the Mourne mountains of Ireland, fine specimens occur, associated with beryl and topaz. Glassy feldspar occurs in great abundance in the trachyte of the Drachenfels on the Rhine; also in the lavas which devastated the island of Ischia near Naples, in 1302. Ice spar is found principally at Vesuvius. It may be obtained in profusion in the valley called Fossa Grande. Porcelain earth, or *kaolin*, occurs at Carclaise and Cigga in Cornwall; at Aue, near Schneeberg in Saxony; on the island of Bornholm in the Baltic; and at Hafnezell, near Passau in Bavaria.

Finely crystallized feldspar occurs in St. Lawrence Co., N. Y., in Rossie, two miles north of Oxbow; the crystals are white or bluish-white, neatly modified, and sometimes an inch across; also eight miles from Potsdam on the road to Pierremont, where crystals a foot through are said to have been found; and near De Long's mill in the town of Hammond, with apatite and zircon. In Lewis Co., feldspar occurs both crystallized and massive in white limestone near Natural Bridge, associated with scapolite and sphene. In Orange Co., crystals presenting the primary form occur near West Point; more abundant and interesting forms are found at Rocky Hill in Warwick, associated with tourmaline and zircon; and at Amity and Edenville. In Saratoga Co., N. Y., the Greenfield chrysoberyl locality affords white translucent crystals, which are usually coated with silvery mica. In Connecticut, the gneiss quarries of Haddam and the feldspar quarries of Middletown occasionally afford crystals a foot in length, and six or eight inches in thickness; near Bradleysville in the western part of Litchfield, crystals two to three inches long are abundant. South Royalston and Barre, Mass., afford interesting crystals often of very large size; also Three Rivers in Palmer. The Acworth beryl locality, the tourmaline locality of Paris, Maine, and three miles west of Attleboro, Penn., are other localities of crystallized feldspar. Fine crystals of green feldspar occur on the island, Mt. Desert, Maine.

Massive feldspar is abundant at the above mentioned localities, besides many others. An aventurine variety, with bright coppery reflections in spots, occurs at Leiperville, Pennsylvania. Adularia occurs at the iolite locality at Haddam, at the Falls of the Yantic near Norwich, Conn., at Brimfield, Mass., with iolite, and at Parsonsfield, Me.; and sunstone at Lyme, Conn. Kaolin occurs at Andover, Mass., and abundantly in New Milford, Kent, and Cornwall, Conn., and in the counties of Essex and Warren, N. Y. Necronite is found at Roger's Rock, Essex Co., and at Thomson's quarry, near 196th street, New York.

Feldspar and especially the clay (*Kaolin*) resulting from its decomposition, are used in making pottery. Moonstone and sunstone are employed as gems.

RYACOLITE. SPATUM VITREUM.

Empyrodox Feldspar, *M.* Ryakolite, *Rose.* Ice Spar, (in part.) Glassy Feldspar. Eisspath, (in part)

Primary form, an oblique rhombic prism. M : M=119° 21'. *Cleavage* parallel with P, and the lateral edge. Occurs in glassy crystals.

H.=6. G.=2·55—2·68; 2·678, (fr. Somma,) Abich. *Lustre* vitreous to pearly. *Color* grayish-yellow to white, or colorless. Transparent. *Fracture* conchoidal.

Composition, according to Rose, (Pogg. xxviii, 143,):

Silica,	50·31
Alumina,	29·44
Perox. iron,	0·28
Lime,	1·07
Magnesia,	0·23
Potash,	5·92
Soda,	10·56=97·81

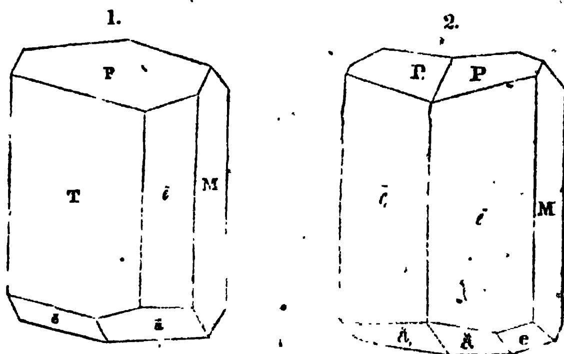
In composition it is allied to Labradorite, but the crystallization of the latter is *oblique rhomboidal*. Before the blowpipe, acts like feldspar, but is a little more easily fusible, and tinges the flame a deeper yellow.

OBS. Occurs in the Dolomite of Somma, along with mica and pyroxene; also in the Eiffel.

ALBITE. SPATUM TRICLINATUM.

Tetarto-Prismatic Feldspar, *M.* Cleavelandite, *P.* and *Levy.* Periklin, *Breit.* Kieselspath, *Haus.* Adinole, *Beud.*

Primary form, an oblique rhomboidal prism; P : M=93° 50′, P : T=115° 5′, M : T=117° 53′. *Secondary forms*:



M : ē=119° 52′, P : ē=119° 51′, P : ă=127° 23′. *Cleavage* perfect, parallel with M and P, with T less so. *Compound crystals*: similar to the above figure; but usually flattened parallel to M, which face is consequently much enlarged;—this is an instance of composition of the *second kind*, or parallel to a plane on a lateral edge of the prism. *Imperfect crystallization* lamellar and granular; the laminæ have sometimes a stellar arrangement; the granular varieties occasionally quite fine, approaching to impalpable.

H.=6. G.=2·6—2·68; 2·612, (fr. Finbo,) Eggertz; 2·619, (fr. Broddbo;) 2·641, variety Pericline. *Lustre* pearly upon a cleavage face; vitreous in other directions. *Streak* white. *Color* white; also occasionally bluish, gray, reddish, greenish, and green; it sometimes exhibits a bluish opalescence. Transparent—subtranslucent. *Fracture* uneven. Brittle.

Composition, according to Eggertz, (Afhand. v, 18,) Rose, (Gilbert's Ann. lxxiii, 173,)

Gmelin, (Kast. Arch. 1824,) Abich, (Pogg. 125, 1840,) and Laurent and Holmes, (Ann de Ch et de Ph lx, 331;)

	Finbo	Arendal	Pericline	Potash Albite, Drachenfels	Cleavelandite
Silica,	70.48	68·46	67 94	70 22	68 4
Alumina,	18·45	19 30	18 93	17 29	20 8
Perox. iron and mang.	—	0 28	Prot 0 48	0 82	0·1
Lime,	0·55	0 68	0 15	2 09	0·2
Magnesia,	—	—	0 00	0 41	—
Potash,	—	—	2 41	3 71	—
Soda,	10 50	9 12	9 98	5 62	10 5
	99 98, E	97 84, R	99 90, G	100 16, A	100 0, L. & H

Before the blowpipe acts like feldspar, but colors the flame distinctly yellow

Obs. The species *Pericline* has been found to be identical with albite, both in composition and crystallization *Cleavelandite* is a white lamellar variety occurring at Chesterfield, Mass, the lamellæ of which are often so arranged as to form wedge-shaped masses

Albite often replaces feldspar as a constituent of granite; in other instances it is associated with feldspar, as in Pompey's pillar, and then may be generally distinguished by its superior whiteness The albite granites are often repositories of several of the granite minerals, tourmalines of different colors beryls, &c It is associated with pearl spar in the Tyrol, where it occurs in large transparent crystals; with epidote and garnet at Arendal with eudialyte and hornblende in Greenland It is frequently one of the constituents of syenite and greenstone Such is the case in the rocks about Edinburgh

In Massachusetts, U S, at Chesterfield it occurs in lamellar masses, (Cleavelandite,) having a slightly bluish tint. It is also met with at the same locality, of a finely granular structure, and rarely in small crystals It is the bed of the fine red and blue tourmalines of Chesterfield. It occurs in a similar manner, containing the same minerals, at Paris, Maine, and at Goshen, Mass., at Acworth and Alstead, N H At Haddam, Conn, it accompanies chrysoberyl, beryl, columbite, and black tourmalines Fine transparent or translucent crystallizations occur at the Middletown Feldspar quarry Granville, Washington Co., N. Y, affords white transparent crystals At Monroe, Conn, a fine granular variety occurs, containing beryl

The name *Albite* is derived from *albus*, white, in allusion to its color, is observed by Gahn and Berzelius, who thus named it in 1814 The variety from Chesterfield was denominated Cleavelandite by Mr Brooke, in honor of Prof Cleaveland The crystallization of albite was first perfectly developed by Dr Gustavus Rose, in Gilbert's Annalen, Feb. 1823 The *Adinole* of Beudant is considered by Kobell, massive albite mixed with quartz.

ANDESIN. Spatum rude.

Andesin, *Abich* in Berz Jahresb xxi year, p 167 Pseudoalbit

Very similar in crystalline form, and in its twin crystals to albite; but the cleavage less distinct, and the surface of cleavage more uneven, and the edges less sharp.

H.=6. G.=2·7328, Abich. *Lustre* and *color* nearly like albite

Composition, according to Abich, (Pogg. li, 523,)

Silica,	59·60
Alumina,	24·28
Peroxyd of iron,	1·58
Lime,	5 77
Magnesia,	1·08
Potash,	1·08
Soda,	6·53=99·92

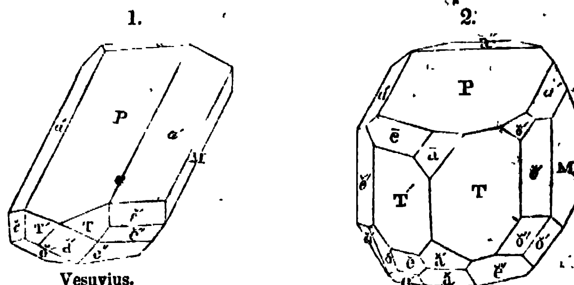
According to this analysis, Andesite is a leucite, in which the potash is replaced by lime and soda. It fuses in thin splinters before the blowpipe, and in powder forms a blebby slag

OBS. It occurs in the Andes at Marmato, near Popayan, in the rock called *Andesite*—a variety of syenite, allied to greenstone. It is mixed with hornblende and quartz. The species was first described by Abich.

ANORTHITE. SPATUM VESUVIANUM.

Anorthomous Feldspar, *M.* Christianite, *Monticelli.* Anorthit, *Rose.* Indianite, *H.* Biotina, *Mont.*

Primary form, an oblique rhomboidal prism; P : T=110° 57′, T′ : T=120° 30′. *Secondary forms:*



Vesuvius.

P : a'=133° 13′, P : ā′=138° 46′. *Cleavage* parallel with P and M perfect. *Compound crystals* of anorthite have not been observed. *Imperfect crystallizations*: structure columnar, or coarse lamellar.

H.=6. G.=2·65—2·78; 2·762 (massive variety,) Rose. *Lustre* of cleavage planes inclining to pearly; of other faces vitreous. *Streak* white. *Color* white. Transparent—translucent. *Fracture* conchoidal. Brittle.

Composition, according to G. Rose, (Gilbert's Ann. lxxiii, 173,) and Abich, (Pogg. li 519,)

	Somma.	Somma.
Silica,	44·49	44·12
Alumina,	34·46	35·12
Perox. iron,	0·74	0·70
Lime,	15·68	19·02
Magnesia,	5·26	0·56
Potash,	——	0·25
Soda,	——=100·63, R.	0·27=100·04, A.

Similar in its action before the blowpipe to the two preceding species, except that with carbonate of soda it does not afford a clear glass, but froths, and forms an enamel. It is entirely decomposed in concentrated muriatic acid.

OBS. Anorthite occurs at Mount Vesuvius, among the old lavas in the ravines of Monte Somma. It generally occupies the cavities of chloritic masses, and is associated with ice spar, augite, mica, and idocrase. It also occurs on the island of Procida, near the entrance to the bay of Naples.

Anorthite was first distinguished as a distinct species by Dr. G. Rose, in 1823, who named it from ανορθος, *oblique*, because all the interfacial angles were oblique. It was afterwards described by Monticelli, in his Mineralogia Vesuviana, and named Christianite, in honor of the crown prince of Denmark. The *Biotine* of Monticelli has been crystallographically examined by Brooke, and shown to be a variety of this species, (Phil. Mag. x, 1837.) Biotine occurs among the volcanic debris of Vesuvius.

The species *Indianite* (Bournon) agrees closely in composition and crystallization with anorthite. It is described as occurring in translucent grains of a greenish-white color, cleaving parallel to two planes, inclined to one another at an angle of 95° 15′. It consists, according to Chenevix and Laugier, of

Silica,	42·5	43·0
Alumina,	37·5	34·5
Lime,	15·0	15·6
Oxyd of iron,	3·0	1·0
Soda,	—=98, C.	2·6=96·7, L.

with a trace of manganese. It is infusible, but becomes friable and gelatinous in acids. It forms the gangue of the Indian corundum, and is found principally in the Carnatic, associated with garnet, fibrolite variety of kyanite, and hornblende.

LABRADORITE. SPATUM OPALESCENS.

Polychromatic Feldspar, *M.* Labrador Feldspar. Anhydrous Scolecite. Silicate, *Thom.*

Primary form, an oblique rhomboidal prism; P : M=93° 28′, P : T=114° 48′, M : T=119° 16′. *Secondary forms,* similar to those of albite. *Cleavage* parallel with P and M most distinct; with T indistinct. It occurs also imperfectly crystallized, with the above cleavages.

H.=6. G.=2·69—2·76. *Lustre* of cleavage faces parallel with P pearly, passing into vitreous. *Streak* white or grayish-white. *Color* gray, brown, or greenish. By varying the position of the specimen, a beautiful *change of colors* may be observed; of these changeable colors, blue and green are the predominant; yellow, red, and pearl-gray, are also apparent. Translucent—subtranslucent.

Composition, according to Klaproth, (Beit. vi, 250,) Thomson, (Min. i, 298,) and Abich, (Pogg. l, 350,)

	Labrador.	Labrador.		Etna.
Silica,	55·75	55·408		53·48
Alumina,	26·50	26·920		26·46
Perox. iron,	1·25	1·508		1·60
Lime,	11·00	10·892		9·49
Magnesia,	——	——	Prot. mang.	2·53
Potash,	——	——		0·22
Soda,	4·00	4·392		4·10
Water,	0·50=99, K.	0·840=99·96, T.		0·42=98·40, A.

The *scolexerose* of Beudant, from Pargas, Finland, is considered a pure lime-Labradorite. According to Nordenskiöld, it consists of Silica 54·13, alumina 29·23, lime 15·45, water 1·07=99·98. Frankenheim makes both *Glaucolite* and *Anhydrous Scolecite* identical with Labradorite.

Before the blowpipe, on charcoal, it acts like feldspar, and fuses with a little less difficulty to a colorless glass. With oxyd of nickel and borax, it affords a blue pearl. It is entirely dissolved by heated muriatic acid, which does not attack either feldspar or albite.

OBS. Labradorite was originally brought from the island of St. Paul, on the coast of Labrador, where is is associated with hornblende, hypersthene, and magnetic iron ore. It occurs abundantly in Essex county, N. Y. Large boulders are met with in the towns of Moriah, Westport, and Lewis: also occasionally in Orange, Lewis, St. Lawrence, Warren, Schoharie, and Green counties.

Labradorite receives a fine polish, and owing to the chatoyant reflections, the specimens are often highly beautiful. It is sometimes used in jewelry.

OLIGOCLASE. SPATUM NITIDUM.

Soda-spodumene, Natron-spodumen, *Berz.*, Jahresb. iv year.

Primary form, oblique rhomboidal prism; P : M=93° 45′, P : T=115° 30′, (Breit.) *Cleavage* very distinct parallel with P; less so with M, and indistinct parallel with T.

H.=6. G.=2·64—2·67. *Lustre*, of P, between vitreous and pearly, of other faces greasy. *Color* yellowish and greenish-white white Transparent—subtranslucent. *Fracture* conchoidal—uneven.

Composition, according to Berzelius (as above) and R Hagen, (Pogg. xliv, 3[illegible])

	Stockholm	
Silica,	63 70	63 51
Alumina,	23 95	23 09
Perox iron,	0 50	——
Lime	2 05	2 41
Magnesia,	0 65	0 77
Potash	1 20	2 19
Soda,	8 11=100 16, B	9 37=101 37, H.

Before the blowpipe it fuses with some difficulty Not acted upon by the acids

Obs Occurs in granite syenite and serpentine, and a yellowish variety in basalt. It is met with at Danvikszoll, near Stockholm, in granite at Arriège, Frankreich, und Aiendal, with calc spar, at Schaitansk, Ural, of greenish white and leek-green colors, in a gangue of gray quartz and black mica, with yellowish-white feldspar; at Clausthal, in a similar gangue, in serpentine

LATROBITE Spatum roseum

Latrobite *Brooke* Ann Phil 2d ser v 383 Diploite *Breit* Amphodelite, *Nordenskiold*

Primary form, an oblique rhomboidal prism; P : M=91° 9′, P : T=98° 30′, M : T=93° 30′; obtained from cleavage planes. *Cleavage* parallel to P, M, and T Occurs also massive.

H 5 5—6 5. G =2 72, Gmelin , 2·8, Brooke. *Lustre* vitreous, of P dull, M and T unequally shining. *Color* a pale rose-red, or a pink, resembling the color of the lepidolite variety of mica. Subtranslucent—opaque.

Composition, according to C G Gmelin (Annals of Phil 2d ser., x, 235) and Nordenskiold, (Jahresb xii, 174,)

			Amphodelite
Silica,	44 653	41 780	45 80
Alumina,	36 814	32 827	35 45
Lime,	8 291	9 787	10·15
Oxyd of manganese,	3 160	} 5 767	——
Magnesia, with some manganese,	0·628		5 05
Potash,	6 575	6 575	Ox iron, 1 70
Water,	2 041	2 041	1·85
	102 162, G.	98 777, G	100,00, N.

Held in the platinum forceps in the blowpipe flame, it fuses with some intumescence to a white enamel With borax, it affords a globule, which has a pale amethyst-red color in the oxydating flame, and is colorless in the reducing flame With salt of phosphorus it melts to a clear glass, containing a skeleton of silica

Obs. Latrobite is found on Ammitok island, near the coast of Labrador, where it is associated with feldspar, mica, and calcareous spar It was discovered by the Rev. C. I. Latrobe Amphodelite, which Breithaupt unites with this species, occurs at the limestone quarries of Lojo in Finland

COUZERANITE

Couzeranite, *Charpentier—Dufrénoy*, Ann de Ch et de Phys. xxxviii, 280.

Primary form, a rhomboidal prism, supposed to be oblique. Crystals long and longitudinally striated.

H.=6—6·5. G.=2·69. *Lustre* vitreous. *Color* gray, greenish-gray—also black.

Cross fracture uneven; longitudinal foliated and conchoidal.

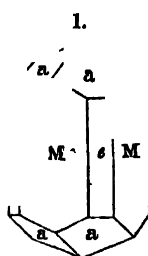
Composition, according to Dufrénoy,
Silica 52·85, alumina 24·25, lime 12·04, magnesia 1·46, potash 5·63, soda 3·75=99·98.
The black variety loses its color when heated on charcoal. Fuses before the blowpipe to a white enamel. Insoluble in acids.

Obs. Couzeranite occurs in the Pyrenees at Couzeran, in slender crystals, in limestone. Kobell suggests that it may be identical with Labradorite.

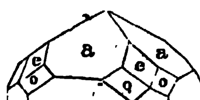
SCAPOLITE. Scapolus pyramidalis.

Pyramidal Elain-spar, *M.* Meionite, Prismato-pyramidal Feldspar, *J.* Dipyre, *P.* Paranthine, Wernerite, *H.* Nuttallite. Tetraklasit, *Haus.* Schmelzstein, Scapolith, Spreustein, *Wern.* Bergmannite?

Primary form, a right square prism. *Secondary forms:*



Gouverneur, N. Y.



Vesuvius.

M : e=135°; e : a=121° 54′, a : a=136° 7′. *Cleavage* parallel with M and e rather distinct, but interrupted. *Imperfect crystallizations*: columnar, lamellarly fibrous, and massive; commonly the particles are strongly coherent.

H.=5—5·5, nearly 6, a subtransparent variety from Gouverneur, N. Y. G.=2·612—2·749. *Lustre* often pearly externally, inclining to resinous; on the cleavage and fracture surface parallel with P, it is vitreous; on the lateral cleavage planes vitreous, inclining to resinous. *Streak* grayish-white. *Color* white, gray, blue, green, and red; colors usually light. Transparent—faintly subtranslucent. *Fracture* subconchoidal. Brittle.

Composition, according to Stromeyer, (Untersuch., p. 378,) Nordenskiöld, (Bidrag. p. 58,) John, and Thomson, (Min. i,)

	Meionite, Somma.	*Scapolite*, Finland.	*Wernerite*.	*Nuttallite*.
Silica,	40·531	41·25	50·25	37·808
Alumina,	32·726	33·58	30·00	25·114
Lime,	24·245	20·36	10·45	18·336
Potash, with soda,	1·812	——	2·00	7·305
Perox. iron,	0·182	——	3·00	Prot. 7·892
Protox. mang.	——	with mag. 0·54	——	——
Water,	——=99·496, S.	3·32=99·65, N.	2·85=98·55, J.	1·500=97·955, T.

Strongly heated in the blowpipe flame it fuses to a vesicular glass, and intumesces considerably; it then assumes the appearance of ice, and continues no longer in fusion. With borax, it dissolves with effervescence and fuses to a clear globule.

Obs. The great variety of appearance among the different specimens of this species, gave rise to its division, by the earlier mineralogists, into several distinct species. *Meionite* includes the pure transparent perfect crystals found in the debris of Mount Somma. *Scapolite* was applied to the translucent varieties of a gray, greenish-gray, or green color. It sometimes occurs of a red tinge, arising from iron. *Wernerite* occurs in short crystals, similar to the second of the above figures, and with darker shades of color than scapolite. *Paranthine* included the more compact varieties of a pure white and pale blue colors. *Dipyre* was distinguished from scapolite, principally, by its reddish-white color and thin columnar structure in imperfectly crystalline varieties.* *Nuttallite* differs from Wernerite only in possessing a tinge of blue with the gray, and a feeble chatoyant reflection of light.

These several varieties of scapolite are usually met with in primitive regions; very often in granular limestone, near its junction with the granite; and in beds of magnetic iron, accompanying this rock. In the latter situation, scapolite occurs at Arendal, in Norway, and Wärmland, in Sweden; also in fine crystallizations in Pargas, Finland, &c. At Arendal it is associated with hornblende and garnet in limestone, and occurs in long slender crystals. *Wernerite* is found in short thick crystals at the same locality. *Paranthine* occurs in the limestone quarries of Malsjö, in Wärmeland. *Dipyre* is confined principally to the torrent of Mauléon, in the western Pyrenees, where it is imbedded in slate.

Highly finished crystals of this species occur at Gouverneur, N. Y., thickly disseminated in primitive limestone, and associated with apatite, sphene, and augite. The crystals are usually thick and short prisms, varying in length from half to two inches, and presenting the form of the first of the above figures. At Two-ponds in Orange county, N. Y., there is a remarkable locality of white and reddish-white crystallized scapolite, containing also pyroxene, sphene, and zircon. The crystals are variously modified, and one has been observed ten inches long and five in diameter. In Warwick of the same county, milk-white crystals occur near Amity, along with pyroxene, sphene, and graphite; also five miles south of Warwick, and also two miles north of Edenville, near Greenwood Furnace, are other localities of crystallized scapolite; in Essex county, perfect crystals and massive forms, nearly fibrous, of white and greenish-white colors, are abundant near Kirby's graphite mine, four miles northwest of Alexandria in Ticonderoga, associated with pyroxene. In Lewis county, N. Y., the variety Nuttallite occurs in fine crystals of white, bluish and dark gray colors, presenting the play of light usual with this variety. The edges of the crystals are often rounded. Bolton and Boxborough, Mass., afford good scapolite, both the common and the variety Nuttallite, often in crystals sometimes of large size; also Chelmsford, Littleton, Chester, and Carlisle. At Parsonsfield and Raymond, near Dr. Swett's house, good crystals are obtained along with yellow garnet and adularia. At Franklin and Newton, N. J., and three miles west of Attleboro', crystallized scapolite occurs in limestone.

Massive scapolite occurs at many of the above localities; also at Marlboro', Vt., Westfield, Mass., Monroe, Conn., white and nearly fibrous, stone quarry at Paugatuck, Stonington, Conn., West Point, N. Y., with pyroxene, and of white and bluish-white colors at Fall-Hill, Monroe, in Orange county, N. Y., along with lamellar pyroxene.

The variety *Bergmannite*, which is frequently described as a distinct species, is stated to occur massive and in promiscuous concretions: *color* grayish, passing into white and brick-red; opaque; *lustre* pearly. It occurs at Stavern, in Norway, associated with feldspar, elæolite, and quartz.

Barsowite of G. Rose, (Pogg. xlviii, 567, 1839,) It resembles Scapolite in external characters and composition, but differs in its action with acids and before the blowpipe. It occurs massive of a coarse granular texture, with a nearly perfect cleavage in one direction.

H.=5·5—6. G.=2·74—2·752. *Lustre* more or less pearly. *Color* snow-white, subtranslucent. *Fracture* granular or splintery.

Composition, according to Varrentrapp, (Pogg. xlviii, 568,)

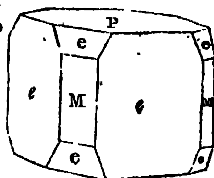
Silica 49·01, alumina 33·85, magnesia 1·55, lime 15·46=99·87.

Before the blowpipe alone, fuses only on the edges to a vesicular glass. Melts slowly with borax to a clear colorless glass. The glass with salt of phosphorus is colorless with little of the salt, but with more, becomes opaline on cooling. Gelatinizes with muriatic acid.

Occurs in boulders in the auriferous sand of Barsovskoi, accompanying blue corundum, greenish-black spinel and white mica.

GEHLENITE. *Scapolus Gehlenianus.*

Pyramidal Adiaphan-Spar, *M.* Stylobite.



Primary form, a right square prism, which is the form it usually presents. *Cleavage* parallel to P imperfect.

H.=5·5—6. G.=2·9166—3·067. *Lustre* resinous, inclining to vitreous. *Streak* white—grayish-white. *Color* different shades of gray; none bright. Faintly subtranslucent—opaque. *Fracture* uneven—splintery.

Composition, according to Fuchs, (Schweig. Journ. xv, 377,) Kobell, (Kastner's Archiv. iv, 313,) and Thomson, (Min. i, 281,)

Silica,	29·64	31·0	29·132
Alumina,	24·80	21·4	25·048
Lime,	35·30	37·4	37·380
Protox. iron,	6·56	4·4	4·350
Water,	3·30	2·0	4·540
Magnesia,	——=99·6, F.	3·4=99·6, K.	——=100·45,T.

Before the blowpipe thin splinters fuse with difficulty to a gray glass. With borax it fuses slowly, forming a vitreous globule colored by iron. Gelatinizes in muriatic acid.

Obs. Gehlenite is found mostly at Mount Monzoni, in the Fassa Valley, in isolated or aggregated crystals, invested by calcareous spar. It also occurs massive in the same neighborhood, forming an exceedingly tough rock, containing imbedded crystals of pleonaste. According to Monticelli, this species is found indistinctly crystallized in calcareous spar at Vesuvius.

Gehlenite was named by Fuchs in honor of his colleague, Gehlen.

Somervillite of Brooke—*Mellilite* of Carpi. These minerals have been lately united by Breithaupt to Gehlenite. The former occurs in pale dull yellow crystals, with black mica and other minerals at Vesuvius; and the former in yellow, reddish, or greenish opaque crystals, with nepheline, in the cavities of a volcanic rock at Capo di Bove and Tivoli near Rome. The above figure represents a crystal of the Somervillite.

HUMBOLDTILITE. *Scapolus acrotomus.*

Monticelli and Covelli. Sarcolite, *Bondi.*

Primary form, a right square prism. *Secondary form*, the primary, with the lateral edges truncated or beveled; also terminal edges or angles replaced; e : e (over M)=83° 10′, e′ : e′ (over M)= 45° 22′, a′ : a′ (over *e*)=64° 6′, a : a (over *e*)=102° 54. *Cleavage* basal, distinct.

H.=5. G.=2·910—3·104. *Lustre* vitreous. *Color* brown or honey-yellow; greenish-yellow. Translucent, and in thin laminæ transparent. *Fracture* conchoidal—uneven.

Composition, according to Kobell, (Schweig. J. lxiv, 293,) Silica 43·96, alumina 11·20, lime 31·96, magnesia 6·10, protoxyd of iron 2·32, soda 4·28, potash 0·38=100·20.

It fuses with difficulty before the blowpipe with effervescence, but without forming a globule. With borax it fuses to a transparent glass. With salt of phosphorus or soda, it fuses with extreme difficulty to a brown opaque enamel. Pulverized, and treated with nitric acid, it gelatinizes.

Obs. It occurs at Vesuvius, in lava, and was described and named by Monticelli and Covelli.

SPODUMENE. Petalus triphanus.

Prismatic Triphane Spar, *M.* Prismatic Spodumene, *J.* Triphan, *L.* Triphane, *H.*

Imperfect crystallizations: structure foliated; yields, by cleavage, rhombic prisms of 93°, (Brooke.)

H.=6·5—7. G.=3·11—3·19; 3·17, Haidinger; 3·188, Thomson; specimen from Dublin Bay. *Lustre* pearly. *Streak* white. *Color* grayish-green, passing into greenish-white and grayish-white. Translucent—subtranslucent. *Fracture* uneven.

Composition, according to Stromeyer, (Untersuch., p. 426,) Thomson, (Min. i, 302,) Hagen, (Pogg. xlviii, 361,) and Regnault, (Ann. des M. 1839, iii, 380,)

	Utön.	Killiney.	Utön.	Utön.
Silica,	63·288	63·812	66·136	65·30
Alumina,	28·776	28·508	27·024	25·34
Lithia,	5·626	5·604	3·836	6·76
Protox. Iron,	0·794	0·828	Perox. 0·321	Perox. 2·83
Protox. Mang.	0·204	Lime, 0·728	Soda, 2·683	——
Moisture,	0·775	0·360	——	——
	99·463, S.	99·840, T.	100·000, H.	100·23

Before the blowpipe it loses its translucency and color, and swells to a foliated reddish-yellow mass, which easily falls to powder. The exterior fuses to small glassy globules.

Obs It occurs on the Island of Utön, in Sudermanland, Sweden, with magnetic iron ore, quartz, tourmaline, and feldspar; also near Sterzing in the Tyrol, and of a pale green or yellowish color, imbedded in granite, at Killiney Bay, near Dublin.

It occurs in granite at Goshen, Mass., associated at one locality with blue tourmaline and beryl; also at Chesterfield, Chester, and Sterling, Mass., at Windham, Maine, near the bridge, along with garnet and staurotide; at Brookfield, Ct., a few rods north of Tomlinson's tavern, in small grayish or greenish-white individuals, looking like feldspar.

The name Spodumene is derived from σποδος, *ashes*, and was given the mineral because it assumes a form like ashes before the blowpipe.

PETALITE. Petalus rhombicus.

Prismatic Petaline-Spar, *M.* Berzelite.

Imperfectly crystallized: *cleavage* parallel to prism of 95°, nearly. Structure sometimes columnar, occasionally impalpable, usually strongly coherent.

H.=6—6·5. G.=2·42, Arfvedson; 2·45, Dr. Clarke; 2·426, C. G. Gmelin. *Lustre* vitreous and glistening; pearly on the faces of perfect cleavage. *Sreak* white. *Color* white, or gray, with occasionally a reddish or greenish tinge. Translucent. *Fracture* imperfectly conchoïdal.

Composition, according to Arfvedson, (Afhand. vi, 145,) Gmelin, (Ann. Phil. xv, 343,) and Hagen, (Pogg. xlviii, 361,)

Silica,	79·212	74·17	77·812
Alumina,	17·225	17·41	17·194
Lithia,	5·761	5·16	2·692
Lime,	trace	0·32	Soda, 2·302
Water,	=102·198, A.	2·17=99·23, G.	—— =100, H.

Gently heated, it emits a blue phosphorescent light. Before the blowpipe, on charcoal, it becomes glassy, subtransparent, and white, and melts only on the edges. With borax, it forms a clear, colorless glass. When boiled in acids, it is partly decomposed.

Obs. Petalite occurs near Stockholm, at the iron mine of Utön, accompanying lepidolite, tourmaline, spodumene, and quartz; also at Bolton, Mass., where it is associated in a lime quarry with scapolite, sphene, and pyroxene.

Lithia was first discovered in this mineral by Arfvedson. The name *petalite* is derived from πεταλον, *a leaf*.

TABULAR SPAR. Grammitus tabularis.

Prismatic Augite-Spar, *M.* Tabular Spar. Table Spar. Grammite. Schaalstein, *W.* Tafelspath, *M.* Wollastonite, *Thom.* and *Beud.*

Primary form: according to Brooke an oblique rhomboidal prism; P: M=126°? P : T=93° 40′, M: T=95° 15′. *Cleavage* perfect and easily obtained parallel to one of the lateral faces; less so parallel with the other; indistinct parallel with P. *Imperfect crystallizations*: columnar; fibres long and slender; often lamellarly arranged; at other times crossing, so as to produce reticulated forms; rather strongly coherent.

H.=4—5. G.=2·78—2·9; 2·785—2·895, (United States,) Thomson; 2·805, (Bannat,) Haidinger. *Lustre* vitreous, inclining to pearly upon the faces of perfect cleavage. *Streak* white. *Color* white, inclining to gray, yellow, red, or brown. Subtransparent—translucent. *Fracture* uneven. Brittle.

Composition, according to Bonsdorff, (Ann. Phil. 2d ser. ii, 300,) Stromeyer, (Untersuch., i, 356,) Vanuxem, (J. Ac. N. Sci. Phil. ii, 182,) and Beck, (Min. N. Y. p. 271,)

	Pargas.			Willsboro', N. Y.	Diana, N. Y.
Silica,	52·58		51·445	51·67	51·90
Lime,	44·45		47·412	47·00	47·55
Perox. iron,	1·13	Protox.	0·401	1·35	0·25
Magnesia,	0·68	Perox. mang.	0·257	——	——
Water,	0·99		0·076	——	——
	99·83, B.		99·591, S.	100·02, V.	99·70, B.

When pure it consists of Silica 51·96, and lime 48·04. Before the blowpipe it fuses with difficulty to a subtransparent colorless glass. With borax it forms readily a clear glass.

Obs. Tabular spar is found in granite and primitive limestone; also in basalt and lavas.

It occurs in the copper mines of Cziklowa in the Bannat of Temeswar. It accompanies garnet, fluor, and native silver, in limestone, at Pargas in Finland, and Kongsberg in Norway. At Castle rock of Edinburgh it is met with in basalt, associated with Prehnite, presenting a fibrous radiated structure. A greenish-white variety occurs in lava at Capo di Bove, near Rome.

In the United States, this species occurs at Willsborough, N. Y., forming the sides of a large vein of garnet, which traverses gneiss; abundantly at Lewis, ten miles south of Keeseville, with colophonite; half a mile north of Lewis corners with garnet and quartz; at Rogers's rock, near the line between Essex and Warren counties, with Garnet and feldspar; Diana, Lewis Co., about a mile from the Natural Bridge, in abundance, of a snow-white color; at Boonville, Oneida Co., in boulders, with garnet and pyroxene: also at Grenville, Lower Canada, associated with green coccolite. It is found in large tabular masses of a fibrous structure, in Bucks Co., Penn., three miles west of Attleboro', associated with scapolite, pyroxene, and sphene.

Dr. Thomson has described under the name of *Wollastonite*, a variety of this species from Kilsyth, where it occurs in greenstone veins. It differs in composition from tabular spar in containing 1 part of trisilicate of soda to 4 of tabular spar.

MANGANESE SPAR. SPATINIUS DECOLORANS.

Bisilicate of Manganese, *Thomson*. Rother Mangankiesel. Rhodonite, *Beud*. Photizite. Allagite. Corneous Manganese.

Primary form, an oblique rhomboidal prism; fig. 104, Pl. II; M : T=121°, M : P=93°—94°, P : T=112° 30′. *Cleavage* perfect parallel with P; less perfect parallel with M and T; also massive. H.=5·5—6·5. Some varieties have a hardness equal to 7. G.= 3·4—3·634. *Lustre* vitreous. *Streak* white. *Color* light brownish-red, flesh-red, sometimes greenish, or yellowish, when impure. Transparent—opaque. *Fracture* conchoidal—uneven. Brittle.

Composition, according to Berzelius,

	Longbanshyttan.
Oxyd of manganese,	52·60
Silica,	39·60
Oxyd of iron,	4·60
Lime and magnesia,	1·50
Water,	2·75=101·05

The impure varieties, *Rhodonite*, *Photizite*, and *Allagite*, contain variable proportions of spathic iron, or carbonate of manganese, and alumine. Prof. Hitchcock has found 10 per cent. of carbonic acid in the spar of Cummington, Mass., owing probably to mixture with carbonate of manganese.

Dr. Thomson has made distinct species of two silicates of manganese from Franklin, New Jersey. One which he calls chemically the simple silicate of manganese, consists of

Silica,	29·64
Protox. manganese,	66·60
Peroxyd of iron,	0·92
Moisture,.	2·70
Alumina,	trace=99·86

Its color is a light brownish-red. Hardness 6·25. Sp. Gr. 4·078. Powder light red. The other, a sesquisilicate, is composed of

Silica,	42·70
Protox. manganese,	50·72
Protox. iron,	6·76=100·18

It occurs in crystals whose primary is the oblique rhomboidal prism; which has been given above as the form of this species. The crystals are often several inches long, and an inch in diameter. H.=6·25. G.=3·586. *Color* brown, slightly reddish. It has been named Fowlerite, in honor of Dr. Fowler.

Before the blowpipe manganese spar becomes dark brown, and melts to a reddish-brown glassy globule. In the oxydating flame it colors borax hyacinth-red, but in the reducing flame, the borax remains uncolored. In powder, it is partly dissolved by muriatic acid, and the insoluble part becomes of a white color. All the varieties grow dark on exposure to the air, and often the weathered surface has nearly a black color.

OBS. The foreign variety on which this species was first instituted, occurs at Longbanshyttan, near Phillipstadt in Sweden, in iron ore beds, sometimes in broad folia, at others granular, and of a paler color; also at Elbingerode in the Hartz; in the district of Ekatherinenburg in Siberia; with gray copper ore at Kapnik in Transylvania.

The same variety occurs in the United States, in large boulders scattered over the fields at Cummington, Mass., and in an extensive bed on Osgood's farm, Blue Hill Bay, Me.

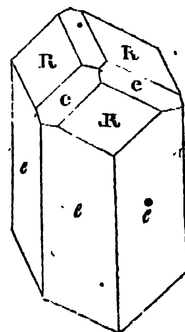
The variety Fowlerite is found at Hamburgh, N. J., near the Franklin furnace, and in Franklin, where it occurs in a bed in limestone, with magnetic iron, Franklinite, and garnet. The silicate of manganese is associated with Troostite, automolite, and red zinc ore, at Sterling, and near the Franklin furnace, N. J.; also at Cumberland, R. I., where it is associated with Yenite.

The varieties allagite, rhodonite, photizite, and corneous manganese, are found near Rübeland in the Hartz.

Manganese spar receives a high polish, and is sometimes employed for inlaid work.

TROOSTITE. SPATINIUS RHOMBOHEDRUS.

Troostite, *Shepard*, Ferruginous Silicate of Manganese, *Thomson*.



Primary form, an obtuse rhombohedron; R : R=115°, measured with the common goniometer. *Secondary form:* R : e=147° 30′, R : e =122° 30′. *Cleavage* perfect parallel to *e*, less distinct at right angles with the axis. Parallel to R in traces. Also massive and granular.

H.=5·5. G.=3·014—3·034, Thomson. *Lustre* vitreous, inclining to resinous. *Streak* white. *Color* pale asparagus-green, yellow, gray, reddish-brown; none bright. Transparent—translucent. *Fracture* conchoidal. Brittle.

Composition, according to Dr. Thomson, (Min. i, 519,)

Silica,	30·650
Protox. manganese,	46·215
Perox. iron,	15·450
Moisture and Carbonic acid,	7·300=99·615

In the blowpipe flame it becomes transparent, and fuses on the edges. To borax it gives the violet tinge of manganese. It dissolves with effervescence in muriatic acid, giving out chlorine.

OBS. Troostite occurs with Franklinite at Sterling, N. J., in beds of primitive limestone.

Tephroite of Breithaupt from Sparta is considered by Shepard a variety of Troostite.

BUSTAMITE. SPATINIUS RENIFORMIS.

A. Brongniart, Ann. des Sci. Nat. viii, 411, 1826.

Occurs in spherical or reniform masses, having a radiated or almost laminated structure.

H.=6—6·5. G.=3·1—3·23. *Lustre* a little silky, but weak. *Color* pale gray, with a slight tinge of green or red. Subtranslucent.

Composition, according to Dumas, (Ann. des Sci. Nat. viii, 411,)

Silica,	48·90
Protox. of manganese,	36·06
Lime,	14·57
Protox. of iron,	0·81=100·34

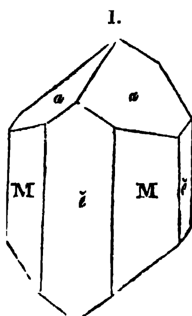
OBS. This mineral was discovered by M. Bustamento, of Mexico, accompanied with quartz and manganese, at Real de Minas de Fetela, and at Inotlco in the province of Puebla, Mexico. It is considered by Dumas a manganesian augite.

PYROXENE. Augitus diatomus.

Paratomous Augite-Spar, *M.* Pyramido Prismatic Augite, *J.* Augite. Coccolite. Diopside Sahlite. Pyrgom. Fassaite. Pentaclasite. Jeffersonite, *Keating.* Asbestus, in part. Green Diallage, Kokkolit, Baikalit, Omphazit *W.* Pentaklasit, *Haus.* Pyroxene, Malacolithe, *Hauy.*

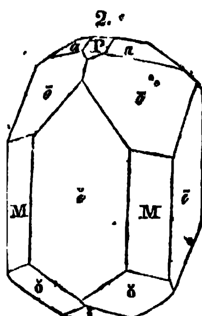
Primary form, an oblique rhombic prism; M' : M=87° 6′, P : M =101° 5′. *Secondary forms:*

1.



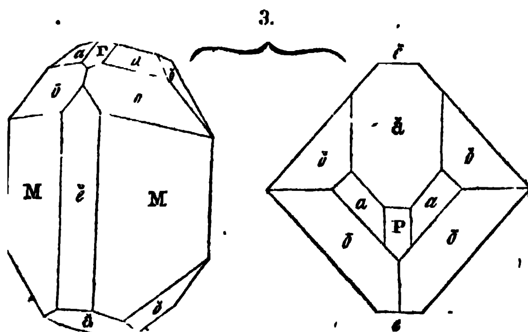
Gouverneur, N. Y

2.



Fassa, Tyrol, and Long Pond Essex Co, N. Y.

3.



Bytown, L. C.; and Ala, Piedmont.

P : a=150° 20′, a : a=120° 39′, ŏ : ŏ=95° 28′, ŏ : ŏ (adjacent planes)=81° 46′, ŏ : ŏ=131° 8′, M : ĕ=136° 28′, M : ĕ=133° 33′, ĕ : ă=105° 59′. *Cleavage* lateral, rather perfect, often interrupted; also parallel to each diagonal. *Compound crystals:* fig. 14, Pl. III; composition of the second kind; parallel to the front lateral edge. *Imperfect crystallizations:* coarse lamellar structure; in large masses, parallel to P or e, arising from an aggregation of separate individuals; the plane of union between the laminæ are joints of composition; granular—particles coarse or fine; fibrous, often fine.

H.=5—6. G.=3·233—3·349. *Lustre* vitreous, inclining to resinous; sometimes pearly. *Streak* white—gray. *Color* green, of various shades, verging on one side to white or grayish-white, and

on the other to brown and black. Transparent—opaque. *Fracture* conchoidal—uneven. Brittle.

This species presents a great variety of forms, and has therefore been subdivided into several varieties. These varieties owe their peculiarities to the isomorphous nature of oxyd of iron and magnesia, which may replace one another without producing a change in the crystalline form. Pyroxene always contains one of these two substances, and according as the iron or the magnesia is more or less abundant the color varies, becoming darker as the iron predominates.

This species may be subdivided into three sections. 1. *Diopside*, or the light-colored varieties; 2. *Augite*, or the dark-colored varieties; 3. *Diallage*, or the thin-foliated varieties. They pass into one another, however, by insensible shades. Section 1 includes the following varieties:

Diopside, *white augite*, or *white malacolite*, of white, grayish or greenish-white colors, either crystallized, lamellar, or granular. When consisting of angular grains rather loosely aggregated, it is called *white coccolite*. *Alalite* is a diopside from Ala in Piedmont. G.=3·23—3·26.

Sahlite occurs in crystalline masses of a grayish-green color, having a coarse foliated structure, arising from composition parallel with P. It resembles Diopside, but has a coarser texture and less lustre. *Baikalite*, *Pyrgom*, and *Fassaite*, are names of dingy green varieties of Sahlite. *Omphazite* is a foliated leek-green variety. G=3·25—3·3.

NOTE. Besides white coccolite, there is *green* coccolite and also black coccolite, or in other words, each variety of augite occurs at times under a granular form.

Composition of light varieties, according to Rose, (K. V. Ac. H. 1820, p. 385,) Bonsdorff and Hisinger, (Afhand. iii, 300,)

	Wärmeland.	Taumare.	Var. *Sahlite*.
Silica,	55·32	54·83	54·18
Lime,	27·01	24·76	22·72
Magnesia,	16·99	18·55	17·81
Protox. of mang.	1·59	——	1·45
Protox. iron,	2·16	0·99	2·18
Alumina,	——	0·28	——
Water,	——=103·07, R.	0·32=99·73, B.	1·20=99·54, H.

Before the blowpipe alone they fuse to a colorless glass. With borax or soda, they easily melt to a transparent glass; with salt of phosphorus, they undergo a slow decomposition, and leave a siliceous residue.

Section 2.

Augite includes the black and greenish-black crystals of pyroxene. G.=3·3—3·4.

Hedenbergite is a greenish-black opaque variety, containing a large proportion of iron. G.=3·5.

Composition of dark varieties, according to Rose, (K. V. Ac. H. 1820, p. 329,)

	Green Malacolite, Dalecarlia.	Dalecarlia.	*Black Augite*.	*Hedenbergite*.
Silica,	54·08	54·55	53·36	49·01
Lime,	23·47	20·21	22·19	20·87
Magnesia,	11·49	15·25	4·99	2·98
Protox. iron,	10·02	8·14	17·38	26·08
Protox. mang.	0·61	0·73	0·09	——
Alumina,	——=99·67	0·14=99·02	——=98·01	——=98·94

Acts before the blowpipe like the preceding, except that the color of the bead is affected by the presence of the iron.

Jeffersonite is a dark-green foliated pyroxene from Franklin, N. J., (*Keating*, J. Ac. Nat. Sci. Phil. ii, 194, and iv, 3, and Troostib. iii, 105.) According to Keating, it consists of Silica 56, lime 15·1, protoxyd of manganese 13·5, peroxyd of iron 10·0, oxyd of zinc 1·0, alumina 2·0, moisture 1·0=98·6. Thomson has lately obtained the following very different result, (Phil. Mag. xxii, 194, 1843,) Silica 44·50, lime 22·15, alumina 14·55, protoxyd of iron 1[illegible]·30, magnesia 4·00, moisture 1·85=99·85.

The above varieties often occur fibrous, constituting much of *asbestus*.

Section 3.

Diallage occurs of various shades of green, gray, and brown, and sometimes has a bronze or pearly-metallic lustre. It cleaves easily into thin laminæ which are brittle. G.=3·11—3·27. It includes *Schiller-spar*, (in part,) and *Bronzite*.

Hypersthene bears nearly the same relation to diallage that the dark varieties of pyroxene bear to the light. It contains a large proportion of iron and little lime, yet varies much in this respect, and some varieties, not distinguishable by external characters, have the composition nearly of diallage. Its colors are grayish or greenish-black, and copper-red, with a bright metallic-pearly lustre. It cleaves easily, but not into as thin folia as the preceding. G.=3·3—3·39. The *Labrador Hornblende* and *Metalloidal diallage* are here included.

Composition, according to Regnault, (Ann. des Mines, 3d ser. xiii, 147,) Köhler, and Klaproth, (Beit. v, 37,)

	Yellowish-green.	Grayish-green.	Greenish-bronze.	Greenish-bronze.	*Bronzite.*	*Hypersthene.*
Silica,	55·84	52·60	50·05	51·25	56·813	54·25
Lime,	*trace*	20·44	15·63	11·18	2·195	1·50
Magnesia,	30·37	16·43	17·24	22·88	29·677	14·00
Prot. iron,	10·78	5·35	11·98	6·75	8·464	24·50
Prot. mang.	*trace*	*trace*	——	——	0·616	*trace*
Alumina,	1·09	3·27	2·58	3·98	2·068	2·25
Water,	1·80	1·59	2·13	3·32	0·217	1·00
	99·88, R.	99·68, R.	99·61, R.	99·36, R.	100·050, Köh.	97·50, Klap.

The specific gravity of the first is 3·241, third 3·261, (from Piedmont,) fourth 3·115.

A hypersthene from Putnam, Lake George, was found by Beck to consist of Silica 45·45, lime 24·33, magnesia 18·00, oxyd of iron 11·49, (Min. N. Y. 310.)

On charcoal, before the blowpipe, diallage melts with difficulty on the edges to a grayish slag; and hypersthene forms a grayish-green semi-opaque glass.

Besides these varieties, there are impure pyroxenes containing largely of steatite, called *steatitic-pyroxenes* by Beudant. The *Rensselaerite* of Emmons, is referred by Beck to this variety. It occurs of white, yellowish, or grayish-white colors, and is sometimes jet-black, and occurs under the same crystalline form as pyroxene. H.=3—4. G.=2·874. *Composition* of the Rensselaerite by Beck, (Min. N. Y., p. 297,) and a steatitic pyroxene from Sahla by Beudant,

Silica,	59·75		60·65
Lime,	1·00		4·97
Magnesia,	32·90		25·20
Peroxyd of iron,	3·40	Protoxyd,	4·18
Oxyd of manganese,	——		0·78
Water,	2·85=99·90, Bk.		4·38=100·16, Beud.

Obs. Pyroxene is principally confined to primitive basaltic or volcanic rocks, and is associated at different localities with granite, granular limestone, serpentine, greenstone, basalt, or lavas. Diallage occurs generally in serpentine or greenstone rocks; and hypersthene with feldspar and quartz forms *hypersthene rock*, which occurs extensively in some primary districts.

Aussig and Teplitz, in Bohemia, afford large crystals of augite imbedded in basalt. It also occurs in small but highly polished crystals in the lavas of Vesuvius, accompanied with nepheline, idocrase, and mica. Diopside is met with in crystals at Ala, in Piedmont, associated with garnets and talc in veins traversing serpentine. Its more transparent crystals from this locality are sometimes polished and worn as gems. Coccolite occurs in veins in primitive rocks at Arendal, in Norway. Sahlite is met with in a similar situation at Sahla, and elsewhere. Baikalite occurs principally on the borders of Baikal, at the mouth of the Sljumanka river. Omphazite accompanies granular garnet at the Sau Alp, in Carinthia; and near Hof, in Bayreuth, with the smaragdite variety of hornblende, which it much resembles.

Beautiful white subtransparent crystals of this species are met with at Bytown, Lower Canada, in limestone, often measuring an inch by one and a half inches. White flattened prismatic crystals, two or three inches long by one or two in breadth, occur in Dolomite at Canaan, Conn.; large green crystals in the limestone of Trumbull; small trans-

parent crystals with granular pyroxene, are found in Reading, Conn., on the turnpike near the line of Danbury. The Bolton quarries, Mass., afford good crystals. The dolomite of New York Co., N. Y., affords both granular and crystallized pyroxene of a white color; the crystals, which are often several inches long, are abundant in the limestone which crosses the island at its north extremity, and also at the abandoned quarries at Kingsbridge, about 208th street. In Orange Co. there are several interesting localities, affording, besides fine crystals, many of the massive varieties, from white to black colors, the former in limestone, the latter usually with magnetic iron. The most noted are that at Two-ponds, in Monroe, where it occurs in simple or grouped crystals, often of large size, and is associated with scapolite, zircon, and sphene in white limestone; another, half a mile east of Greenwood furnace, along with mica in limestone, where one crystal was obtained six inches long and ten in circumference; and two and a half miles north of Edenville, gray crystals of interesting forms. Near Amity and Fort Montgomery, are other good localities. Dark-green or black crystals occur in limestone a mile northwest of Edenville. In Putnam Co., near Patterson, grayish-white crystals are abundant, strewed over the surface and in limestone. In Westchester Co., a white variety occurs at the Sing Sing quarries. Other good localities in New York, are at Rogers's Rock, Lake George, crystallized, massive, and granular, (coccolite,) of gray, green, and brown colors; on the banks of Vrooman lake, near Oxbow; in Diana, Lewis Co., in black crystals. Franklin, N. J., also affords good pyroxene. Massive varieties occur at most of the above mentioned localities. A beautiful green coccolite occurs near Long Pond, Essex Co., N. Y., and a black coccolite in Monroe, Orange Co., a mile west of Coffee's Hotel; at Willsboro', N. Y., green coccolite is associated with sphene and tabular spar. A beautiful lamellar variety of a dark-green and bronze color is abundant in the Forest of Dean, Orange Co., N. Y., along with black coccolite; and fine Sahlite with coccolite about three miles southeast of Greenwood furnace. Diopside occurs on Hustis's farm, Phillipstown, N. Y., and in the Bolton limestone quarry. Raymond and Rumford, Maine, afford several of the massive varieties, diopside, Sahlite, &c. At Berkshire, Mass., a white variety is abundant. A broad lamellar Sahlite of a white color is found at Watertown, Conn., at the lime quarry near the Naugatuck, and a less interesting grayish-green variety at the verd antique quarries of Milford and New Haven. Both crystals and granular pyroxene are found near Attleboro', Penn. Diallage occurs in serpentine in Westfield and Blanford, Mass., at Deer Isle, Maine, Cooptown, Harford Co., Md.

Hypersthene is stated to occur in Essex Co., in much of the granite of that region, often associated with labradorite; also near Wilmington, Delaware. But the mineral from these localities, although presenting the external characters of this variety, differ much from one another in composition, and still more from the foreign hypersthene, of which the analysis is given above, (see Beck's Min., N. Y.) Rennselaerite occurs in beds in the towns of Fowler, Dekalb, Edwards, Russel, Gouverneur, Canton, and Hermon, St. Lawrence Co., N. Y., and at the two latter places in crystals; also in Oxbow near Antwerp, in crystals, and near Butterfield Lake, Jefferson Co., N. Y.

Pyroxene was thus named by Haüy, from *πῦρ*, *fire*, *ξένος*, *stranger*, in allusion to its occurrence in lavas, where, according to a mistake of Haüy, it did not naturally belong, or was a stranger. The name *Augite* is derived from *αὐγη*, *lustre*, alluding to the fact, that its lustre is usually superior to that of hornblende.

Crystals of this species have been obtained by fusion, and are not unfrequent, of a black color, among the iron slags of Sweden. Mitscherlich and Beudant have succeeded in forming white crystals, by mingling silica, lime, and magnesia, and subjecting them in a charcoal crucible to the heat of a porcelain furnace.

The *Hudsonite* of Beck (Min. N. Y., p. 405) has the cleavage of pyroxene, especially some massive varieties, and approaches Hedenbergite in composition. The following are its characters as given by Beck. H.=4·5—5. G.=3·50. *Lustre* vitreous to resinous. *Color* black, often with a brownish tarnish. *Streak* green. Opaque. *Composition*, according to Beck, Silica 37·90, oxyd of iron 36·80, alumina 12·70, lime 11·40, magnesia 1·92. Alone, before the blowpipe, it fuses with effervescence to a black bead, attractable by the magnet. It occurs in a vein of quartz in Cornwall, Orange Co., N. Y., where it was found by Dr. Horton.

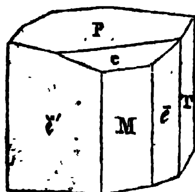
The *Polylite* of Dr. Thomson is a closely allied mineral, although differing in containing manganese. It is described as resembling hornblende, or still more Arfwedsonite, in appearance. H.=6·25. *Color* black. *Composition*, according to Thomson, Silica 40·04, protoxyd of iron 34·08, protoxyd of manganese 6·60, alumina 9·42, lime 11·54, water 0·40. Hoboken is stated as the locality of Polylite; but Dr. Beck suggests that there must

be some mistake in this, as it is said to occur in a bed of magnetic iron, and none is known to exist there.

Common pyroxene is of no use in the arts. The Rensselaerite is worked like steatite into inkstands, and when finely compact, it receives a good polish. The light colored varieties are translucent, and when worked up look like porcelain.

BABINGTONITE. AUGITUS ACROTOMUS.

Axotomous Augite-Spar, *M.* *Levy*, Ann. Phil. 2d ser. vii, 275.



Primary form, an oblique rhomboidal prism; P : M=92° 34′, P : T=88°, M : T=112° 30′, P : e=150° 25′, M : ē=137° 5′, M : ĕ=132° 15′, ē : ĕ=89° 20′, Levy. *Cleavage* perfect, and easily obtained parallel with P, less perfect in the direction of T.

H.=5·5—6. G.=3·4—3·5. *Lustre* vitreous, splendent. *Color* dark greenish-black; thin splinters green perpendicular to P, and brown parallel to the same; faintly translucent Large crystals, opaque, or faintly subtranslucent. *Fracture* imperfectly conchoidal.

evaporation 0·9=100·5. Before the blowpipe ... With borax it affords a clear amethystine globule, which becomes green in the reducing flame.

OBS. Babingtonite occurs in distinct crystals at Arendal, in Norway, associated with epidote and massive garnet, and in the Shetland Isles, imbedded in white quartz. It was named in honor of Dr. Babington by Mr. Levy, who first distinguished it as a species; it resembles some dark varieties of pyroxene.

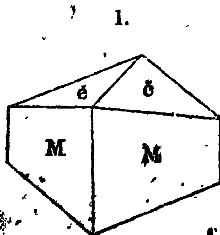
In the United States it is said to occur, coating crystals of feldspar, at Gouverneur, St. Lawrence Co., N. Y.

HORNBLENDE. AUGITUS PROTEUS.

Hemi-Prismatic Augite-Spar, *M.* Axotomous Schiller-Spar or Green Diallage, Hemi-Prismatic Augite, *J.* Actinolite, Tremolite, Calamite, Pargasite, Smaragdite, Asbestus, in part, Amianthus, Amianthinite, Amianthoid, Lotalite, Amphibole, Actinote, Strahlstein, Tremolith, Kalamit, Amiant, *W.* Grammatit, Byssolith, *Haus.*

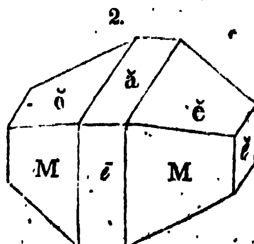
Primary form: an oblique rhombic prism; M : M=124° 30′, P : M=103° 1′. *Secondary forms:*

1.



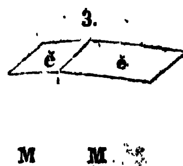
Edenville, N. Y.

2.

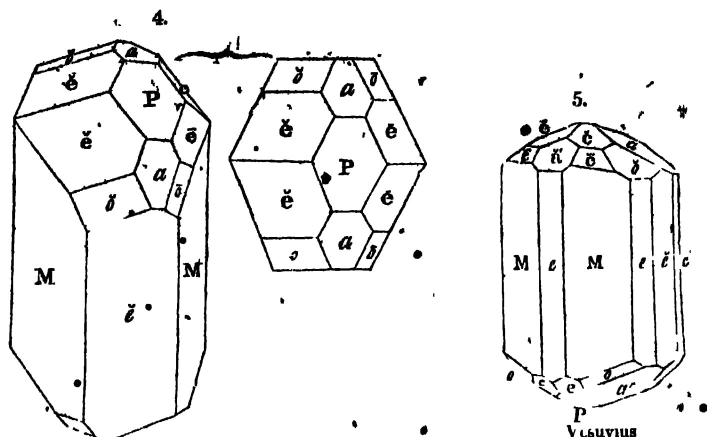


Gouverneur, N. Y.

3.



Teplitz, Bohemia, and Sterling Mine, Or. Co., N. Y.



ĕ : ĕ=148° 30′, ă : ĕ=164° 15′, ă : ĕ=104° 45′, M : ĕ=152° 15′, M : ĕ=117° 45′. *Cleavage* lateral, highly perfect: sometimes distinct parallel to the diagonals. Lateral planes often longitudinally striated.

6.

Compound crystals: composition of *the second kind*, parallel to the obtuse edge M : M. The simple crystals of this form are represented in fig. 3. *Imperfect crystallizations:* fibrous and slightly divergent columnar; columns coarse or fine, often filiform, and sometimes lamellar: granular; particles of various sizes usually strongly coherent; sometimes friable.

H.=5—6. G.=2·9—3·2; 2·931, tremolite variety; 3·026, actinolite, from Zillerthal; 3·167, basaltic hornblende, from Lower Stiria. *Lustre* intermediate, between vitreous and pearly on cleavage faces; occasionally true pearly; vitreous parallel to P. Some fibrous varieties have a silky lustre. *Streak* white, grayish-white, brown. *Color* various shades of green, inclining to blackish green and a pure black on the one side, and white on the other. Occasionally, almost transparent; usually subtranslucent—opaque. *Fracture* subconchoidal, uneven. Brittle.

Few minerals, if any, present a greater diversity of appearance than hornblende. In the earlier state of the science it was, therefore, distributed into several species, which crystallographic considerations have now shown to be varieties of the same species. The differences arises mostly from a variation in the proportion of alumina, magnesia, and oxyd of iron, the color depending principally on the latter. The following are the more important of these varieties:—

Tremolite—Grammatite. Tremolite comprises the white, grayish, greenish, or yellowish-white specimens, presenting the same crystallizations with hornblende. The crystals are often in long slender blades, either distinct and traversing the gangue, or aggregated in columnar and radiated masses. G.=2·93. Transparent—translucent

Actynolite. The bright green varieties of hornblende are called actynolite; if in distinct crystals, *glassy actynolite.* The crystals are long, slender prisms, and break easily

across the prism. The fibrous or radiated crystallizations are often named *asbestiform actynolite*. The green color is owing to a small proportion of oxyd of iron; and on account of the iron present the specific gravity of actynolite is above that of tremolite,—usually between 3.02 and 3.03.

Asbestus,* when of a white color or some light shade, is a fibrous variety of tremolite or actynolite. The fibres are often as fine as flax, and may be separated with the fingers. By traversing limestone or the gangue that contains it, it often gives an asbestiform appearance to large masses of the rock. The more delicate varieties, presenting the lustre of satin, are called *amianthus*.—The fibres of asbestus are sometimes so interlaced that the fibrous structure is not apparent; this variety is called *mountain leather* and *rock* or *mountain cork*. The former occurs in tough, flexible laminæ or sheets, resembling leather, and the latter has the feel and nearly the texture of cork. Both are so light, owing to the loose interlacing of the fibres, as to float on water.

These varieties contain no alumina, and consist, according to Bonsdorf, (K. V. Ac. H. 1821,) and Meitzendorf, (Pogg. lii, 626,) of

	Tremolite		Glassy Actynolite	Asbestus. Zillerthal
Silica,	60.31	60.10	59.75	55.869
Magnesia,	24.23	24.31	21.10	20.334
Lime,	13.66	12.73	14.25	17.764
Alumina,	0.26	0.42	——	——
Protoxyd of iron,	0.15	1.00	3.95	4.309
Prot. manganese,	—	0.47	0.31	1.115
Hydrofluoric acid,	0.94	0.83	0.76	——
Water,	0.10	0.15	——	——
	99.65, B.	100.01, B.	100.12, B.	99.391, M.

Pargasite. Pargasite or Pargas hornblende, includes crystallized varieties of high lustre and rather dark shades of green.

Hornblende. The name hornblende as originally applied, belonged only to the dark green and black varieties, whether in crystals or massive. It contains a larger proportion of iron than either of the above varieties, and has a sp. gr. from 3.1 to 3.4. When massive it constitutes the toughest of all rocks.

These varieties contain alumina and consist, according to Bonsdorf, (K. Vet. Ac. H. as above,) of

	Pargasite	Hornblende	
Silica,	46.26	48.83	45.69
Magnesia,	19.03	13.61	18.79
Lime,	13.96	10.16	13.83
Alumina,	11.48	7.48	12.18
Protoxyd of iron,	3.48	18.75	7.32
Prot. of manganese,	0.36	1.15	0.22
Hydrofluoric acid,	1.60	0.41	1.50
Water,	0.61	0.50	——
	96.78	100.89	99.53

In addition to the above varieties we also include here the *Uralite* of Rose, which occurs under the crystalline form of pyroxene, with the *cleavage* of hornblende. Also the *Arfwedsonite* of Brooke. *Composition* according to Thomson, Silica 50.508, peroxyd of iron 35.144, sesquoxyd of manganese 8.92, alumina 2.488, lime 1.56, moisture 0.96=[illegible] (Min. i, 483.) G.=3.35—3.369. *Color* black. *Cleavage* eminent. It occurs at [illegible] luarsuk in Greenland, associated with sodalite and eudialyte.

Before the blowpipe hornblende readily enters into fusion, attended with a slight [illegible]tion. The *white* varieties form a subtransparent glass, the *green*, a glass, colored more or less by the iron they contain. With borax it fuses easily, producing a similar globule. It is not decomposed with salt of phosphorus, after a long blast, the glass (of white varieties) becomes opaline on cooling. With a very small portion of carbonate of soda, it

* Asbestiform varieties of the species *augite*, are also common, which are with difficulty distinguished from those of hornblende.

fuses to a transparent or colored glass as above. More of the flux causes an intumescence, and the formation of an infusible scoria.

OBS. The variety hornblende of this species is one of the constituents of syenite and greenstone. It also forms beds in primitive regions. Frequently it possesses a slaty structure, and is then called hornblende-slate. Hornblende also occurs in primitive limestone. Actinolite is found in the greatest perfection in talcose rocks, and tremolite occurs most abundantly in granular limestones and dolomite. Asbestus often traverses serpentine rocks and granular limestones.

Aussig and Toplitz in Bohemia, Tunaberg in Sweden, and Pargas in Finland, afford fine specimens of the dark colored hornblendes. Actinolite occurs at Saltzburg and Greiner, in the Zillerthal; Tremolite, at St. Gothard, in primitive limestones or dolomite; also at Sebes in Transylvania, the Tyrol, the Bannat, Gulsjö in Sweden, Glentilt, &c. A soft asparagus-green variety occurs at Normarken in Sweden, in prisms in serpentine; it has been called *calamite*. Asbestus is found in Savoy, Saltzburg, the Tyrol; also in the island of Corsica, where it is so abundant that Dolomieu employed it in packing his minerals. Rock cork is obtained in Saxony, Portsoy, and Leadhills, where also mountain leather occurs. Oisans, in France, affords a variety of amianthus, composed of fibres having some degree of elasticity. It is the *amianthoide* of Haüy.

In the United States, black crystals of hornblende occur at Franconia, N. H.; at Chester, Mass.; at Thomaston, Me.; at Moultonboro', Me., in Syenite; at Willsboro', N. Y., presenting interesting crystalline forms; also near the bridge at Potsdam, St. Lawrence Co., N. Y.; near Greenwood Furnace, and in Warwick, Orange Co., N. Y. Interesting crystals of a dark green color occur near the Two Ponds, and also a mile north—two and a half miles north, and a mile south of Edenville, together with gray or hair brown crystals and tremolite, sphene, and chondrodite, in granular limestone. Near Amity hornblende occurs of various forms and colors, and often in large and perfect crystals; in dark green crystals, with ilmenite, at the Stirling mines, Orange Co.; at Gouverneur, in short green crystals, sometimes two or three inches in diameter, along with apatite; in Rossie, two miles north of Oxbow, the variety pargasite in neat bright green crystals. Pargasite occurs also at Phipsburg and Parsonsfield, Me. Gray hornblende in good crystals is found at Bryam, N. J., and other interesting varieties at Franklin and Newton of the same State. Large flattened crystals of a white color occur abundantly in dolomite at Cannan, Conn., between the falls and the post office, and other places in Litchfield Co.; also at Lee (one and a half miles southwest of the meeting house) and Newburg, Mass. Glassy actynolite in beautiful specimens occurs in the steatite quarries of Windham, Readsboro' and New Fane, Vt., and at Middlefield and Blanford, Mass.; also near a hamlet called Pecksville in Fishkill, N. Y. Radiated or asbestiform actynolite occurs at the same localities; also at Unity, Me.; at Brown's serpentine quarry, three miles northwest of Carmel, Putnam Co., N. Y.; at Franklin, N. J.; at Carlisle, Pelham, and Windsor, Mass.; in Buckingham Co., Willis's Mt., Va. Radiated and asbestiform tremolite occur abundantly in the dolomite of New England and New York. The principal localities are at Thomaston and Raymond, Me.; Lee and Great Barrington, Mass.; in New York at Dover, Kingsbridge, the Eastchester quarries, at Hastings and near Yonkers in Westchester Co.; at Knapp's quarry, Patterson, and on the banks of Yellow lake and elsewhere in St. Lawrence Co., N. Y. The same varieties occur at Franklin, N. J.; in Pennsylvania at Chesnut Hill, near the Wissahicon, and London grove, near Philadelphia; at the Bare Hills, Md.

Asbestus is met with at many of the above localities, besides others; at West Farms, Winchester, Wilton, and Milford, Conn.; at Brighton, Sheffield, Pelham, Newbury, and Dedham, Mass.; in New York, near Greenwood Furnace, Rogers's farm in Patterson, Colton rock and Hustis's farm in Phillipstown, (both asbestus and amianthus,) near the quarantine, Richmond Co., asbestus and a straw-colored amianthus with the fibres between two and three feet in length; at Chesnut Hill, Penn.; Cooptown and Bare Hills, Md.; and Barnet's Mills, Fauquier Co., Virginia. Mountain leather occurs at the Milford quarries, Conn.; also at Brunswick, New Jersey.

A variety of hornblende, on the island of Corsica, admits of a high polish, and is known to the Italian lapidaries under the name of *Verde de Corsica duro*. Asbestus was manufactured into cloth by the ancients, who were acquainted with its incombustibility. This cloth was often the material for their napkins, and was preferred for this purpose on account of the ease with which it was cleansed; it was merely necessary to throw them into the fire. This material was also employed for the wicks of lamps in the ancient temples, and because it maintained a perpetual flame without being consumed, was named ασβεστος, (asbestos) *unextinguished*. It is now used for the same purpose, by the natives of

Greenland The ancients also called it ἀμίαντος, (*amiantus*,) *undefiled*, because of the simplicity of the means of restoring it, when soiled, to its original purity The best locality for collecting it for this purpose is near the quarantine, Richmond Co, New York

Hornblende was thus named in allusion to its extreme toughness, in this respect slightly resembling horn The radiating, or divergent structure, frequently presented by *actinolite*, suggested this name from ἀκτίν, a ray *Tremolite* was first found at Tremola in Switzerland and *Pargasite*, at Pargas in Finland

The *Masonite* of Jackson (Geol Rep of Rhode Island, p 88) is allied to foliated hornblende It occurs in tabular crystallizations, disseminated through a compact argillite, near Natic village Rhode Island *Structure* foliated Folia brittle A transverse cleavage may be detected, indicating a rhombic primary *Color* dark gray *Lustre* nearly pearly H 6 G=3 450 Folia brittle *Composition*, according to Jackson, Silica 33 20, alumina 29 00, magnesia 0 21 protoxyd of iron 25 934, oxyd of manganese 6 00=99 974 Before the blowpipe it fuses with difficulty to a dark green enamel

M Gustavus Rose, in an article exhibiting much research, (Pogg 1831,) has proposed the union of the species hornblende and pyroxene In physical characters they are similar, and in chemical composition the differences have been shown to be unessential by the discovery of the principles of isomorphism Crystallographic characters first led Werner to distinguish these minerals, but as Rose has pointed out, the crystals of one may be secondary to the primary of the other, according to one of the simplest and most common kinds of modification One of the horizontal axes in the primary of pyroxene is just half what it is in hornblende * The only real difference then is in cleavage, which yields the different forms assumed as the primaries of these minerals Rose remarks, however, that there are instances of crystals of pyroxene with the cleavage of hornblende, and that such a cleavage in the imperfect crystallizations are not uncommon

Rose suggests that the different forms of the two minerals may be owing to the rapidity of cooling at the time of their formation, and as pyroxene has been observed in the slags of furnaces, and may be formed by fusing the constituents together, which is not true of hornblende, he infers that the crystals of this mineral are the result of rapid cooling, while hornblende requires a slow reduction of temperature

Notwithstanding the above facts, we deem it preferable, as it is attended with fewer perplexities to the student to continue pyroxene and hornblende as distinct species The perfect crystals of the two are well characterized, both as to form and cleavage, and are easily distinguished, and each stands at the head of a long series of varieties which, with very few exceptions, are equally characteristic

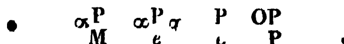
ANTHOPHYLLITE AUGITUS PHYLLINUS

Anthophyllite *Schumacher* Prismatic Schiller Spar *M* Strahliger Anthophyllite *W* Strelite

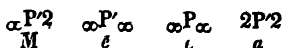
Primary form, a rhombic prism; M M about 125° 30′, and 54 30′ *Cleavage* parallel to M and both diagonals; that parallel to the longer diagonal the most distinct.

H 5 5 5 G 2 94—3 1558 *Lustre* submetallic, inclining to pearly. *Streak* white. *Color* between gray and dark clove-brown, also brownish green Translucent—subtranslucent. Brittle

* The description of figure 3 of hornblende is as follows



And the description of figure 1 of pyroxene, referred to the primary of hornblende, is



Composition, according to Vopelius, (Pogg. xxiii, 355,) Gmelin, (Pogg. xxiii, 358,) and Thomson, (Min. i, 207,)

Silica,	56·74	56	57·12
Alumina,	——	3	trace
Magnesia,	24·35	23	25·92
Lime,	——	2	1·32
Protox. iron,	13·94	13	13·52
Protox. mang.	2·38	4	——
Water,	1·67=99·08, V.	—=101, G.	1·36=99·24, T.

Alone, before the blowpipe, it remains unaltered. With borax it melts with difficulty to a grass-green transparent bead.

Obs. Anthophyllite occurs in promiscuous fibres and foliated distinct concretions, in beds of mica slate, accompanied by garnet, pyroxene, tourmaline, iolite, &c. The cobalt and copper mines of Kongsberg, and of Snarum, near Modum in Norway, are among its foreign localities. It also occurs at Ujordlersoak in Greenland, associated with pyroxene.

At Haddam, Conn., it is associated with tourmaline and iolite, in mica slate. It is also found in the same rock with quartz, at Chesterfield, Chester, and Blanford, Mass., and Guilford, Conn.; also near Carmel, Putnam Co., N. Y.

This mineral approaches hornblende very closely in external characters and composition. Its lateral interfacial angle has been stated at 124° 30′, which is identical with that of hornblende.

The name *anthophyllite* was given by Schumacher; it alludes to its resemblance in color to the anthophyllum.

CUMMINGTONITE. Augitus scopiformis.

Imperfectly crystalline: structure thin columnar, divergent, scopiform, stellular, rather incoherent.

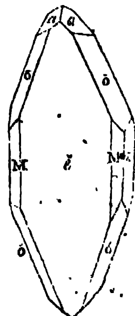
H.=6—6·5. G.=3·2014. *Lustre* somewhat silky. *Color* ash-gray. Translucent—opaque. Brittle.

Composition, according to Muir, (Thom. Min. i, 493,) Silica 56·543, protoxyd of iron 21·669, protoxyd of manganese 7·802, soda 8·439, volatile matter 3·178. Before the blowpipe, *per se*, it is infusible, except on thin edges. With carbonate of soda it fuses with effervescence to a dark glass. With borax it forms a black glass.

Obs. It occurs in mica slate, at Cummington and Plainfield, Mass., associated with garnet and iron pyrites.

ACMITE. Augitus cuspidatus.

Achmite. Akmit, *Haid.* *Stromeyer* and *Berzelius*, Kong. vet. Ac. Handl. 1821, p. 160.



Primary form, an oblique rhombic prism; M : M=86° 56′. *Secondary form:* M : ĕ=133° 28′, M : ĕ=136° 32′; a : a=119° 30′. *Cleavage:* lateral distinct; diagonal less so. Plane ĕ often longitudinally striated. *Compound crystals:* composition of the *second kind* parallel to ĕ. These forms are of common occurrence.

H.=5·5—6. G.=3·2—3·4; 3·398, Thomson. *Lustre* vitreous, inclining to resinous. *Streak* pale yellowish-gray. *Color* brownish or reddish-brown; in the fracture blackish-green. Opaque. *Fracture* uneven—earthy. Brittle.

Composition, according to Berzelius, (K. V. Ac. H. 1821, p. 160,) and Lehunt (T. Min. i, 480.)

Silica,	55·25		52·016
Perox. iron,	31·25	Protox.	28·080
Soda,	10·40		13·333
Perox. mang.	1·08	Protox.	3·487
Lime,	0·72		0·876
Magnesia,	—		0·504
Alumina,	——98·70, B.		0·685=98·981, L.

Before the blowpipe it readily fuses to a black bead. Not attacked by acids. Acmite is closely allied to augite and hornblende.

Obs. Acmite occurs at Rundemyr, about four miles north of Dunserud, near Kongsberg in Norway. It is there met with in crystals, nearly a foot long, imbedded in feldspar and quartz. They are often macled and bent, and are detached with difficulty, on account of their frangibility.

The name of this species is derived from ακμη, *a point*, in allusion to the pointed extremities of the crystals. It has been improperly spelt *achmite*.

AMBLYGONITE. Augites lithiferus.

Amblygonic Augite Spar, *Haid.*

Primary form, a rhombic prism; but whether right or oblique is uncertain; M : M=106° 10′, and 73° 50′. Planes M usually rough. *Cleavage* parallel to M producing brilliant surfaces. Also massive, columnar.

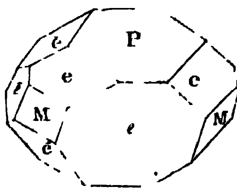
H.=6. G.=3—3·04. *Lustre* vitreous, inclining to pearly on the faces of perfect cleavage. *Color* pale mountain- or sea-green. Subtransparent—translucent. *Fracture* uneven.

Composition, according to Berzelius, 55·69 of Phosphoric acid, 35·69 of alumina, and 9·11 of lithia. Before the blowpipe it fuses easily with intumescence, and becomes opaque and white on cooling. With borax it forms a transparent colorless glass.

Obs. This species has hitherto been found only at Chursdorf, near Penig in Saxony, where it is associated with tourmaline and garnet in granite. It was first ranked as a species by Breithaupt. The name *amblygonite* is derived from αμβλυς, *blunt*, and γονη, *angle*.

TURNERITE.

Levy, Ann. of Phil. xviii, 241. Pictite.



Primary form, an oblique rhombic prism; M : M=96° 10′, P : M=99° 40′. *Secondary form :* M : ē=138° 5′, M : ĕ=131° 55′, P : ē=133° 50′. *Cleavage* parallel with both diagonals of the prism, one more perfect than the other. H. above 4. *Lustre* adamantine. *Streak* white or grayish. *Color* yellow or brown. Transparent—translucent.

According to Children, it contains alumina, lime, magnesia, and a little iron; and it differs from sphene, of which it has been considered a variety, in containing very little silica and no titanium.

Obs. Accompanies quartz, albite, feldspar, Crichtonite, and anatase, at Mount Sorel in Dauphiné. It was distinguished by Levy, and named in honor of Mr. Turner, in whose collection it was first found.

CARPHOLITE

Karpholite J

Structure columnar in radiated and stellated tufts, particles rather incoherent

H. about 5 G =2 935, Breithaupt, 2 9365, Stromeyer *Lustre* silky, glistening. *Color* pure straw yellow, sometimes wax yellow. Opaque Very brittle.

Composition, according to Stromeyer, (Untersuch, 410,) and Steinmann, (Schweig Jour xxv, 413,)

Silica,	36 154	37 53
Alumina,	28 669	26 47
Perox manganese,	19 160	18 33
Protox iron,	2 290	Perox 6 27
Lime,	0 271	——
Fluoric acid,	1 470	——
Water,	10 780=98 794, Strom	11 36—99 96, Stein

It intumesces before the blowpipe, whitens and fuses slowly to a brown opaque mass With borax it forms a transparent glass, which, in the outer flame, assumes an amethystine color, in the reducing flame it becomes green

OBS It occurs in minute divergent tufts disposed on granite, along with fluor and quartz, in the tin mines of Schlaggenwald It was named by Werner, in allusion to its color, from καρφος, straw

BREISLAKITE

Occurs in delicate capillary crystals of a reddish brown or chesnut brown color, bent and grouped like wool; fibres flexible *Lustre* metallic

It contains Silica, alumina, and iron, but according to late examinations no copper With salt of phosphorus it affords a green globule, which is red in the reducing flame

OBS. It forms woolly coatings in the cavities of lavas, and accompanies nepheline and pyroxene It has been observed at Vesuvius and Capo di Bove, near Rome

KYANITE Epimecius cyaneus

Prismatic Disthene Spar M Disthene, H Cyanite Fibrolite Sappar, Rhœtizit W

Primary form, an oblique rhomboidal prism, P M=93° 15′, P : T=100° 50′, M T=106° 15′. *Secondary form*, the primary with the obtuse lateral edge, or with both obtuse and acute lateral edges replaced. M *e*=145° 16′, T · *e*=140° 59′, M ĕ=131° 25, T ĕ=122° 20′. *Cleavage*. lateral, perfect, less distinct parallel with T and *e*. Crystals usually long and flat prisms, often aggregated and divergent, straight or curved, occasionally fine fibrous *Compound crystals* · composition of the *first kind*, parallel to M

H= 5—7, the lowest degrees on M, the highest on the solid angles and terminal edges. G =3 559—3 675, the former of a milk-white variety of Rhætizite, the latter of a blue transparent specimen which had been cut and polished *Lustre* pearly upon M, particularly the cleavage face, inclining to vitreous on other

faces. *Streak* white. *Color* blue or white; also gray, or even black; frequently blue along the axis of the crystal, white each side. Transparent—subtranslucent. *Fracture* uneven. Brittle.

Composition, according to Arfvedson, (K. V. Ac. H. 1821, p. 147,) Chenevix, and Rosales, (Pogg. lvii, 160,)

Silica,	34·33	36·9	37·0	38·00	36·67
Oxyd of iron,	——	——	——	0·75	1·19
Alumina,	64·89	64·7	62·5	58·25	63·11
	99·22, A.	101·6, A.	99·5, A.	97·00, C.	100·97, R.

Unaltered alone before the blowpipe. With borax it fuses slowly to a transparent colorless glass.

Obs. The white varieties of this species were formerly ranked as a distinct species, under the name of *Rhætizite*.

Kyanite occurs principally in gneiss and mica slate, and is often accompanied by garnet and staurotide.

Transparent crystals of this species are met with at St. Gothard in Switzerland, Styria, Carinthia, Bohemia: Villa Rica in South America, also affords specimens of this species. A fine blue lamellated variety is found at Botrifny in Banffshire. The white or *rhætizite* variety occurs principally at Kemeten in the Pfitsch Valley, Tyrol.

At Chesterfield, Mass., it occurs with garnet in mica slate; the prisms have white sides and a blue centre; Worthington and Blanford in the same State, afford good specimens. In Connecticut, it occurs at Litchfield and Washington in large rolled masses with corundum and massive apatite; at Oxford, near Humphreysville, the mica slate contains nests of quartz thickly traversed by kyanite. Kyanite occurs in fine specimens near Philadelphia on the Schuylkill road near the Darnby bridge; it also occurs near Schuylkill on the Ridge road, back of Robin Hood Tavern; in Maryland, eighteen miles north of Baltimore at Scott's mills; near Wilmington, Delaware, fibrous approaching to bladed crystallizations; in Willis's Mt., Buckingham Co., and two miles north of Chancellorville, Spotsylvania Co, Va.; on the road to Cooper's gap in Rutherford Co., N. C. A variety in short crystals, (sometimes called improperly fibrolite,) is abundant at Bellows Falls, Vt., in gneiss, at Westfield and Lancaster, Mass., and at Jaffrey on the Monadnock Mt., N. H. A black variety associated with rutile occurs in North Carolina.

Kyanite, when blue and transparent, and in sufficiently large masses, is employed as a gem, and has some resemblance to sapphire.

This species was named in allusion to its color, from κυανος, *blue*. The name, sappare, arose from a mistake by Saussure, in reading a label of this mineral, on which it was named *sapphire*.

WŒRTHITE. Epimecius albus.

Hess, Pogg. xxi, 73.

Has been observed only in rolled masses, having a foliated crystalline structure.

H.=7·25. G. above 3. *Lustre* similar to that of kyanite. *Color* white. Translucent.

Composition, according to Dr. Hess, (Pogg. xxi, 73,)

Silica,	40·58	41·00
Alumina,	53·50	52·63
Magnesia,	1·00	0·76
Water,	4·63	4·68
Peroxyd of iron,	trace=99·71	——=99·02

Heated in a glass tube it becomes opaque, and gives out water. Dissolves slowly with borax, but undergoes no perceptible change with salt of phosphorus. When moistened with nitrate of cobalt, and strongly heated, it assumes a beautiful dark blue color.

This species was discovered by Mr. Von Worth, near St Petersburgh, and an account of it published by Dr. Hess It has been considered a variety of kyanite

DIASPORE Empticius dissiliens

Euklastic Disthene Spar, *Haid* Dihydrate of Alumina, *Thom*

Primary form, according to Phillips, an oblique rhomboidal prism; P : M=71° 30′, P : T=78° 40′, M : T=65°; according to Dufrénoy, the specimens from Siberia give M : T=127°, and P on the lateral plane, 100° or 102°. *Cleavage* eminent parallel to a diagonal; also lateral and basal, less perfect. Occurs in irregular lamellar prisms.

H.=6—6·5. G.=3·4324, Haüy. *Lustre* vitreous, brilliantly splendent on cleavage faces. *Color* greenish-gray or hair-brown When thin, translucent—subtranslucent.

Composition, according to Vauquelin, (Ann de Chimie, xlii, 113,) Children, (Ann Phil 2d ser iv, 146,) and Dufrénoy, (Ann des M 1837,)

Alumina,	80·0	76·06	74·66
Protoxyd of iron,	3·0	7·78	4·51
Silica,	—	—	2·90
Lime and magnesia,	—	—	1·61
Water,	17·3=100·3, V.	14·70=98·54, C	14·58=98·29, D

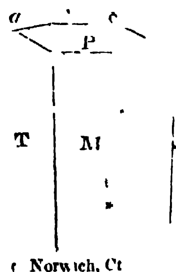
In the blowpipe flame it decrepitates with violence, and splits into numerous scaly particles, which fuse readily with borax to a colorless glass According to Berzelius, these particles, after being slightly heated, will restore the blue color of reddened litmus paper Mr Children did not succeed in obtaining this result

Obs The locality of diaspore was for a long time unknown Mr Fiedler has lately reported that it occurs in primary limestone, not far from Ekatherinenburg in the Marmor bruch, at the ...ck of the Koroibrod. Its superior lustre distinguishes it from kyanite, some varieties of which it much resembles

Diaspore is so named from its action under the blowpipe, from διασπειρω, *to scatter*

SILLIMANITE Elimecius Sillimanianus.

Bowen Jour Phil Acad Nat Sc iii, 375 American Journ. of Science, viii, 113



Primary form, an oblique rhombic or rhomboidal prism; M : T=110° to 98°; crystals having the faces M smooth and plain, give the latter, which therefore appears to be the correct angle of the prism. *Secondary form*, the annexed figure; P : M=105°, P : e=133° 30′, M : e=120° 30′, P : *a*=132°, (D.) The terminal planes dull and hardly smooth. *Cleavage* highly perfect, parallel to the longer diagonal, and producing brilliant surfaces; parallel to M indistinct. Crystals usually long and slender. Occurs also long fibrous, parallel or slightly divergent.

H.=7—7·5. G.=3·2—3·238, D; 3·259, N. (Yorktown.) *Lustre* vitreous, inclining to pearly; hardly shining on M, but splendent on the face of perfect cleavage; parallel to P, vitreous, inclining to resinous. *Streak* white. *Color* hair-brown—grayish-

brown. Translucent. *Fracture* uneven, parallel to P. Brittle. The long crystals are detached from the rock entire, with great difficulty, on account of their frangibility.

Composition, according to Bowen, (Sill. Jour. viii, 113,) Muir, (Thom. Min. i, 424,) Connell, (Jameson's Jour. xxxi, 232,) and Norton, performed in the laboratory of B. Silliman, Jr., for this work,

Silica,	42·666	38·670	36·75	37·700
Alumina,	54·111	35·106	58·94	62·750
Zirconia,	—	18·510	—	—
Oxyd of iron,	1·999	7·216	0·99	2·287
Water,	0·510	—	—	—
	99·286, B.	99·502, M.	96·68, C.	102·739, N.

The analyses by Connell and Norton show that this mineral contains no Zirconia. Before the blowpipe, both *per se* and with borax it is infusible.

Obs. The crystal here figured appears to have dissimilar lustre on M and T, and this, as well as the secondary planes, indicates that the primary is probably a *rhomboidal* prism. In composition, Sillimanite is very close to Kyanite, if they are not identical; yet its bright and easy cleavage shows that it is mineralogically distinct from that species.

Sillimanite occurs in slender prisms often flattened and striated, thickly traversing quartz in a vein of gneiss at Chester, Conn.; also at the falls of the Yantic, near Norwich, Conn., associated with minute zircons and monazite. Prisms half an inch in diameter are occasionally met with. It also occurs in the town of Yorktown, Westchester Co., N. Y., about ten miles northeast of Sing Sing, near the road leading from Pine's Bridge to Yorktown Post Office, associated with monazite, tremolite, and magnetic iron; the crystals are distinct and often run through the iron ore.

This species was named by Bowen in honor of Prof. B. Silliman, of Yale College.

BUCHOLZITE. Epimecius Bucholzianus.

Brandes, Schweigger's Jour. xxv, 125, 1819. *Thomson*, Roy. Trans. xl, 263. Anhydrous Silicate of Alumina, *Thom.* Fibrolite. Xenolite, *Nord.*

Imperfectly crystalline; structure fibrous. An acicular crystal of Xenolite presented the form of a three-sided prism with two angles of 45° 38′, and one of about 90°, seeming to indicate as the primary, a rhombic or rhomboidal prism of 91°, (about,) with a diagonal cleavage.

H.=6—7. G.=3·193; of Xenolite, 3·58. *Lustre* pearly and glistening. *Streak* white. *Color* white, or gray, inclining to yellow. Thin fragments slightly translucent—subtranslucent. *Fracture* conchoidal, perpendicular to the fibres. Brittle, and easily frangible.

Composition, according to Brandes, (J. de Phar. xci, 237,) Thomson, (Min. i, 235,) and Komonen, (Act. Soc. Sc. Fennica, i, 372,)

	Tyrol.	Chester, Penn.	*Xenolite.*
Silica,	46·0	46·40	47·44
Alumina,	50·0	52·92	52·54
Potash,	1·5	—	—
Oxyd of iron,	2·5=100, B.	trace=99·32, T.	—99·98, K.

Obs. Bucholzite was originally obtained from Fassa, in the Tyrol. It has since been discovered at Chester, Pennsylvania, on the Delaware, near the Queensbury forge, and elsewhere, in Monroe, Orange Co., N. Y., at Humphreysville, Conn., and at Worcester, Mass. Bucholzite is named after Bucholz, a celebrated German chemist.

The *Xenolite* of Nordenskiöld is shown to be identical with this species by Teschemacher, in the Proceedings of the Bost. Nat. Soc. for 1843, p. 109. It was found in boulders in the province of Petershoff in Finland.

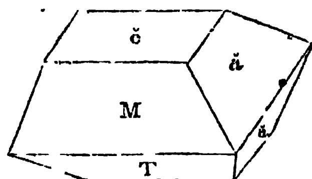
ORDER VI. HYALINEA.

EPIDOTE. Carbunculus rhomboideus.

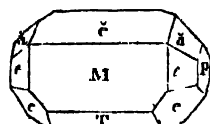
Prismatoidal Augite-Spar, *M.* Epidote, *H.* Zoisite. Pistacite. Withamite. Thallite. Akanticon. Scorza. Delphinite. Arendalite. Bucklandite, *Levy*. Piemontischer Braunstein, *W.* Eisenepidot, Manganepidot. Thulite. Puschkinite, *Wagner*.

Primary form, a right rhomboidal prism; M : T=115° 24′. *Secondary forms:*

1.

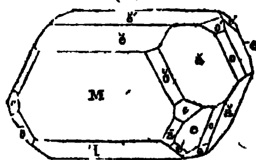


Harlem, N. Y.

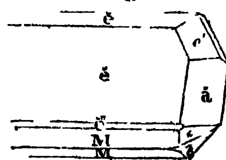


Amity, N. Y.

3.



4.



Haddam, Conn.

M : ĕ=116° 17′, T : ĕ=128° 19′, ă : ă=109° 27′. ĕ : ă=125° 16′. M : e=121° 34′, M : ĕ′=90° 33′. T : ĕ′=154° 3′, ĕ : ĕ′=154° 16′. T : e=144° 31′. *Cleavage* perfect parallel to M, less so to T. *Compound crystals:* composition of the *first kind* parallel to T; also parallel to ĕ, or the shorter diagonal, as in figure 4. *Imperfect crystallizations:* structure columnar, divergent, or parallel; granular, particles of various sizes, sometimes impalpable.

H.=6—7. G.=3·25—3·46; 3·425, Haidinger; 3·46, Descotils; 3·289, Thomson, var. Scorza. *Lustre* vitreous, inclining to pearly upon M, both as faces of crystallization and cleavage. *Streak*

grayish-white. *Color* green or gray mostly; green colors usually somewhat yellowish. Crystals commonly less yellow in the direction of the vertical axis, than at right angles with it. The gray colors occasionally pass into red and white. Subtransparent—opaque; generally subtranslucent. *Fracture* uneven. Brittle.

This species includes three subdivisions. Pistacite or Epidote proper,—*lime-and-iron-epidote;* Zoisite—*lime-epidote;* and *manganesian epidote,* containing manganese as well as iron. Zoisite has usually a gray, brownish or bluish-gray, or white color. Epidote, a green color of some shade, often pistachio-green, and Manganesian epidote a reddish-brown or reddish-black color. This last variety is the *Piemontischer Braunstein* of Werner. *Bucklandite,* according to Rose, is a pure *iron-epidote.*

Composition, according to Laugier, (Ann. de Ch. lxix, 320,) Thomson, (Min. i, 365 and 271,) Bucholz, (Gehlen's J. 2d ser. i, 197,) and Hartwall, (Pogg xvi, 483,)

	Epidote.	*Epidote.*	*Zoisite,*	*Zoisite.*	*Mang. Epidote.*
Silica,	37·0	38·240	40·25	39·300	38·47
Alumina,	26·6	18·828	30·25	29·488	17·65
Lime,	20·0	24·080	22·50	22·956	21·65
Protoxyd of iron,	13·0	17·440	Perox. 4·50	6·480	6·60
Protoxyd of mang.	0·6	Mag. 0·480	——	——	Perox. 14·08
Water,	1·8	0·800	2·00	1·360	Mag. 1·82
	99·0, *L.*	99·868, *T.*	99·50, B.	99·584, T.	100·27, H.

Sobrero detected 0·40 per cent. of oxyd of tin and copper in a manganesian epidote.

Epidote fuses with difficulty before the blowpipe, and only on the thinnest edges, to a transparent glass. With borax it intumesces, and ultimately affords a clear globule. Zoisite swells up and melts on the edges to a yellow glass; with borax it fuses to a diaphanous glass. Manganesian varieties tinge the flame an amethystine color.

Obs. Arendal, in Norway, affords magnificent crystallized specimens of this species, and has given the name *Arendalite* to the epidote of its localities. Large translucent crystals occur at Aggruvan, near Nordmark in Sweden. Bourg d'Oisans is a fine locality of pistachio-green crystallized specimens. Zoisite occurs accompanying kyanite, hornblende, and titanium, in the Sau Alpe and the Bacher Mountain in Styria, in the Tyrol, &c. The manganesian variety occurs at St. Marcel, in the valley of Aosta, in Piedmont. Bucklandite occurs at Arendal and in the lavas of the Laachersee.

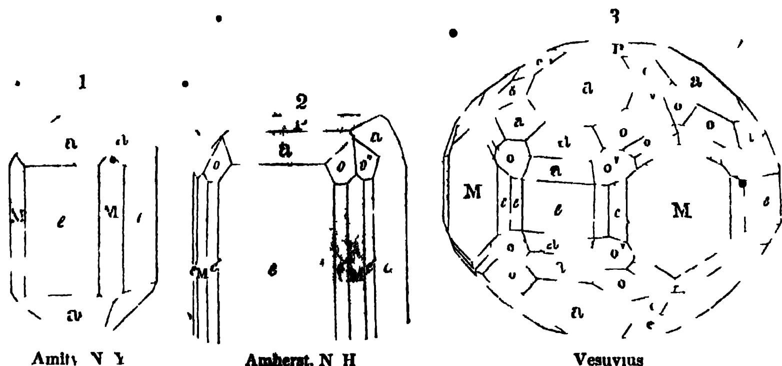
At Franconia, N. H., both crystallized and granular epidote are abundant. The granular contains dodecahedral crystals of magnetic iron. Large crystals of unusual beauty are obtained at Haddam, Conn. Epidote occurs also in crystals at the gneiss quarries of Hadlyme and Chester; in limestone at Newbury, Mass.; in greenstone near Nahant; in hornblende slate at Rowe, Mass.; fine crystallizations in syenitic gneiss, at Athol, Mass., two miles southwest of the centre of the town; at Warren, N. H., with quartz and pyrites; at Cumberland, Rhode Island, in a kind of trap; in gneiss at Harlem, on the banks of East River, near 38th street; two miles southeast of Amity, N. Y., in quartz; two miles south of Carmel, Putnam Co., N. Y., with hornblende and garnet; two miles north of Coffee's, Monroe, Orange Co., N. Y., in granite; at Franklin, New Jersey, a massive variety occurs six miles west of Warwick, N. Y., of a pale-yellowish-green color, associated with sphene and pyroxene. Zoisite in columnar masses is found at Willsboro', Vt.; at Montpelier, of a bluish-gray color, associated with calc spar in mica slate; at Chester, Mass.; in mica slate; also at Goshen, Chesterfield, Hinsdale, Heath, Leyden, Williamsburg, and Windsor, in Massachusetts, and at Milford, Conn.

The name *Epidote* was derived by Haüy from ἐπιδίδωμι, *to increase,* in allusion to the fact, that the base of the primary is frequently very much enlarged in some of the secondary forms. *Zoisite* was so named in compliment to its discoverer, Baron Von Zois.

IDOCRASE CARBUNCULUS DIMETRICUS

Pyramidal Garnet *M* Vesuvian *Werner* Loboit *Frugardit* Idokras *of the Germans* Idocrase, *H* Wiluite Cyprine Xanthite, *Mather* Gokumite

Primary form, a right square prism *Secondary forms* fig 1, of a crystal from Amity, N. Y, and elsewhere, figs. 2 and 3, of crystals from Vesuvius.



P . a=142° 53′, M · e=[illegible], M · e′=153° 26′, M e″=161° 34′, e a′=146° 33′, e a″=161° 43′, a : e=154° 44½′, o^v o^v=146° 25′, P e 151° 56′ *Cleavage* parallel with M not very distinct, still less distinct parallel with P. *Imperfect crystallizations* columnar structure rare—particles straight and divergent, or irregular, occasionally granular.

H.=6 5 G =3 349—3 399. *Lustre* vitreous, often inclining to resinous *Streak* white *Color* brown, passing into various shades of green, green colors frequently bright and clear, occasionally sulphur-yellow. In some varieties, the color appears oil-green in the direction of the axis, and pistachio-green at right angles with it Subtransparent—faintly translucent *Fracture* subconchoidal—uneven

Composition according to Magnus (Pogg xxi, 50) and Varrentrapp, (Pogg xlvi, 343,)

	Vesuvius	Slatoust	The Bannat	Slatoust
Silica,	37[illegible]9	37 178	38 519	37 55
Alumina,	23[illegible]0	18 107	20 063	17 88
Protoxyd of iron,	3[illegible]2	4 671	3 420	6 34
Lime,	29[illegible]1	35 791	32 411	35 56
Magnesia, }	5[illegible]08	0 773	2 987	2 62
Protox mang }	=99 77, M	1 495=98 015, M	0 018=97 418, M	——=99 95, V

In the blowpipe flame it fuses with some effervescence to a translucent yellow globule and forms, with borax, a diaphanous glass, tinged with iron By fusion the specific gravity is reduced to 2 9[illegible]45, according to Magnus, without any change of composition

OBS Idocrase was first observed in the ancient Vesuvian lavas, and was thence called Vesuvian It has since been met with in serpentine, gneiss, and primitive limestone The Vesuvian idocrase has a hair-brown or olive-green color, and is associated with ice spar, garnet, mica, and nepheline The crystals are commonly small several have been

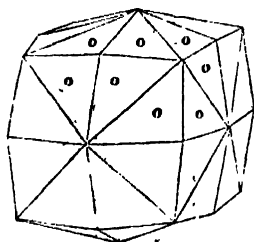
found, however, which exceed an inch in each direction. The finest specimens occur at Ala, in the Val di Brozzo, in Piedmont; they are usually subtransparent, of brilliant lustre, and have green or brown colors; rarely perfectly black. Egge, near Christiana, in Norway, Wilui river, Lake Baikal, Monzoni, in the Fassa valley, are other localities. Crystals of a sulphur-yellow color have been found at the latter place. Liver-brown diverging groups, are brought from Eger, in Bohemia, whence the name *Egeran*, for specimens of this species. Crystals of a blue tint, called *cyprine*, have been described by Berzelius, from the vicinity of Tellemarken, in Norway. The color is supposed to be owing to the presence of a minute portion of copper.

Phipsburg and Rumford, just below the Falls, in Maine, afford fine crystals and massive idocrase associated with yellow garnet, pyroxene, &c., in limestone. At Parsonsfield, Me., it occurs in large crystals with the same associated minerals, and is abundant. It also occurs at Poland, Me. It has been collected at Worcester, Mass., in a quartz rock, with garnet, but the locality is exhausted. A yellowish-brown idocrase occurs in crystals at Newton, N. J., associated with corundum and spinel. Half a mile south of Amity, N. Y., grayish and yellowish-brown crystals, sometimes an inch in diameter, occur in granular limestone; also at the village and a mile east of the village, of yellow, greenish-yellow and yellowish-brown colors. The *Xanthite*, which is from this vicinity, is identical in crystallization with common idocrase. Light yellow crystals are met with in granular limestone on Muscalonge lake, Jefferson Co., N. Y.

The name *idocrase*, given by Haüy, is derived from ειδω, *to see*, and κρασις, *mixture*, because its crystalline forms have much resemblance to those of other species.

GARNET. Carbunculus dodecahedrus.

Dodecahedral Garnet, *M.* and *J.* Melanite. Pyrope. Grossularite. Topazolite. Almandine. Aplome. Essonite, Cinnamon stone. Greenlandite. Pyrenaite. Colophonite. Allochroite. Granat. Pirop. Kolophonit. Romanzovit, *Nordenskiöld*. Braunsteinkiesel, *W*. Grénat, *H*. Carbunculus. Polyadelphite, *Thom*. Kaneelstein.



Primary form, the dodecahedron. *Secondary forms*: Pl. I, figs. 11, 16, 18, 27; also several of these in combination; also the annexed figure, which is similar to fig. 25, a hexoctahedron. *Cleavage* dodecahedral, indistinct. Planes E often striated parallel to their common intersections, and occasionally parallel to the shorter diagonal of the faces. *Imperfect crystallizations*: lamellar—laminæ thick and bent; granular—coarse or fine to impalpable; strongly coherent—friable.

H.=6·5—7·5. G.=3·5—4·3. *Lustre* vitreous—resinous. *Streak* white. *Color* red, brown, yellow, white, green, black; none bright, except red and green colors. Transparent—subtranslucent. *Fracture* subconchoidal, uneven.

Garnet is a compound of three or four silicates—Silicate of alumina, lime, iron, and manganese. It has been divided into four sub-species; one consisting of silicates of alumina and lime and called alumina-lime garnet, including common garnet and colophonite in part and cinnamon stone or essonite; 2. consisting of silicates of iron and lime—iron-lime garnet—including allochroite, aplome, melanite and common garnet in part; 3. consisting of silicates of alumina and iron—alumina-iron garnet—including alamandine or precious garnet; and 4. consisting of silicates of alumina and manganese—alumina-manganese garnet—or manganesian garnet. But these compounds are seldom distinct and they pass into one another by imperceptible shades, as the following analyses show. The following are the varieties that have received distinct names.

Grossular occurs in greenish trapezohedrons. *Cinnamon stone* presents a bright cinnamon-yellow color and high lustre. *Common garnet* presents a dull red or brownish red color and is translucent or subtranslucent. *Precious garnet* has a rich brownish red color

and is often transparent. *Melanite* occurs in velvet black crystals. *Pyrenaite* is a black or grayish-black variety, often presenting a submetallic lustre. *Allochroite* is a fine-grained massive garnet of dark or dingy shades of color. *Topazolite* occurs in small yellow crystals. *Aplome* has the faces of the dodecahedron striated parallel with the shorter diagonal. *Manganesian garnet* presents a brownish red color and gives the reaction of manganese with borax before the blowpipe. *Colophonite* is a coarse granular variety consisting of large angular grains which often have a resinous lustre (whence the name *Garnet resinite*) and are iridescent. The usual color is a dark brownish-red, but it also occurs of bright red, brown, and yellow colors. The *Polyadelphite* of Thomson is a brownish-yellow garnet from Franklin Furnace, New Jersey.

Composition, according to Lehunt, (Thom. Min. i, 266,) Wachtmeister, (K. V. Ac. H. 1823, p. 141, and 1833, p. 138,) Klaproth, (Beit. ii, 26,) Richardson, (Phil. Mag. xv, 86, 1839,) Vauquelin, Simon, and Seybert, (Sill. J. vi, 155,)

	Grossular.	Essonite.	Aplome.	Melanite.	Melanite.	Allochroite
Silica,	40·55	39·826	35·64	42·450	35·50	35·0
Alumina,	20·10	20·141	——	22·475	6·00	8·0
Lime,	34·86	30·574	29·21	6·525	32·50	30·5
Perox. of iron,	5·00	9·459	30·00	Prot. 9·292	25·25	17·0
Protox. mang.	0·48	——	3·02	6·273	0·40	Carb. lime, 6·0
Magnesia,	——	——	Potash, 2·35	13·430	——	3·5
	100·99, W.	100·000, L.	100·22, W.	100·450, W.	99·65, V.	100·0, V

	Pyrenaite.	Colophonite.	Colophonite.	Precious Garnet.	Manganesian Garne
Silica,	43	37·0	37·60	35·75	35·83
Alumina,	16	13·5	14·40	27·25	18·06
Lime,	20	29·0	27·80	——	——
Protox. iron,	16	7·5	} 13·35	Perox. 36·00	14·93
Perox. mang.,	—	4·8		0·25	Prot. 30·96
Magnesia, water,	4	6·5	6·55	——	——
	99, V.	98·3, Si.	100·70, R.	99·25, K.	99·78, Sey.

These several varieties fuse with some difference of facility to a dark vitreous globule, which in the varieties containing largely of iron, acts sensibly on the magnet.

Ouvarovite, according to Komonen, is a *Lime-chrome-garnet*, and consists of Silica 37·11, alumina 5·88, oxyd of chrome 22·54, protoxyd of iron 2·44, lime 30·34, magnesia 1·10, water 1·01=100·42. G.=3·4184. H.=7·5.

Obs. Garnet occurs imbedded in mica slate, granite, and gneiss, and occasionally in limestone, chlorite slate, serpentine, and lava.

The precious garnet occurs in the greatest perfection in Ceylon and Greenland. Common garnet is met with in dodecahedrons from three to four inches in diameter, at Fahlun in Sweden, Arendal and Kongsberg in Norway, and the Zillerthal. It occurs abundantly in crystals of less size, in mica slate, in the island of Mull, the shires of Perth and Inverness, Shetland. Green crystals are met with at Swartzenberg in Saxony. Melanite is found in the Vesuvian lavas, and also near Rome. *Grossularite* occurs near the Wilui River in Siberia. *Cinnamon stone* is met with in masses of considerable size in the primitive rocks of Ceylon. *Aplome* occurs on the banks of the river Lena in Siberia, and at Swartzenberg in Saxony. The *Ouvarovite* of M. Hess of St. Petersburg occurs in emerald green dodecahedrons, at Bissersk in Russia.

Hanover, N. H., affords small symmetrical crystals, transparent, and of a rich brownish-red color disseminated in syenitic gneiss. Dark blood-red, and highly splendent dodecahedrons, with beveled and truncated edges, occur at Franconia, N. H., in geodes, in massive garnet, calcareous spar, and magnetic iron ore.

At Haverhill, N. H., garnets, some an inch and a half in diameter, occur in chlorite: at Unity, on the estate of J. Neal, garnets are associated with actinolite and magnetic iron, and at Lisbon, near Mink Pond, in mica slate with staurotide. At Carlisle, Mass., beautiful geodes of transparent cinnamon-brown crystals, similar to figure 18, Plate I, accompany scapolite in granular limestone. Boxborough, in the same region, affords similar but less remarkable specimens; also the gneiss at Brookfield and Brimfield. A massive garnet occurs with epidote at Newbury, Mass., and crystals at Bedford, Chesterfield, with the Cummington kyanite, and at the beryl locality of Barre. Beautiful yellow garnets or cinnamon stone are associated with idocrase at Parsonsfield, Phippsburg, and

Rumford, Maine; the manganesian garnet also occurs at Phippsburg, as well as the finest yellow garnet in Maine. The mica slate near the bridge at Windham, abounds in garnets, along with staurotide; also granite veins at Streaked Mountain, along with beryl. Large reddish-brown crystals occur at Buckfield, on the estates of Mr. Waterman and Mr. Lowe. The best red garnets yet discovered in Maine, occur at Brunswick. Finely polished trapezohedrons, from half an inch to an inch in diameter, occur in mica slate at Monroe, Conn. Large brittle trapezohedrons of manganesian garnet, often two inches through, are associated with the chrysoberyl of Haddam. The chlorite slate at New Fane, Vt., affords large dodecahedral crystals, two inches or more in diameter. At Lyme, Conn., blackish-brown crystals of large size (fig. 18, Pl. I,) occur in limestone. In New York, the mica slate in Dover, Dutchess Co., abounds in small garnets. At Rogers's Rock, crystallized as well as massive garnet and colophonite of yellow, brown, and red colors, are abundant. A brown garnet in crystals occurs at Crown Point, Essex Co.: a cinnamon variety, crystallized and massive, is met with at Amity. On the Croton aqueduct, near Yonkers, small rounded crystals and a beautiful massive variety are found, and the latter, when polished, forms a beautiful gem. Franklin, N. J., affords black, brown, yellow, red, and green dodecahedral garnets: also near the Franklin furnace. Colophonite forms a large vein in gneiss at Willsborough, Essex Co., N. Y., associated with tabular spar and green coccolite; also at Lewis, ten miles south of Keeseville, Essex Co. Cinnamon stone, in fine trapezohedral crystals, occurs at Dixon's quarry, seven miles from Wilmington, Delaware.

The cinnamon stone from Ceylon and the precious garnet are prized as gems when large, finely colored, and transparent. Pulverized garnet is sometimes employed as a substitute for emery.

The garnet was, in part, the carbunculus of the ancients. This term was probably applied also to the spinel and Oriental ruby. The Alabandic carbuncles of Pliny were so called because cut and polished at Alabanda.* Hence the name Almandine, now in use. Pliny describes vessels of the capacity of a pint, formed from carbuncles, " non claros ac plerumque sordidos ac semper fulgoris horridi," devoid of lustre and beauty of color, which probably were large common garnets. The garnet is also supposed to have been the hyacinth of the ancients.

PYROPE. CARBUNCULUS CUBICUS.

Bohemian Garnet.

Primary form, a cube. Generally in rounded grains. *Cleavage* none.

H.=7·5. G.=3·69—3·8. *Lustre* vitreous. *Color* blood-red. Transparent—translucent. *Fracture* conchoidal.

Composition, according to Kobell (Min. 187) and Wachtmeister, (K. V. Ac. H. 1825, p. 216,)

		Meronitz.
Silica,	43·00	43·70
Alumina,	22·26	22·40
Oxyd of chromium,	1·80	7·68
Magnesia,	18·55	5·60
Protoxyd of iron,	8·74	11·48
Lime,	5·68	6·72
Oxyd of manganese,	——=100·36, K.	3·68=101·26, W.

According to late investigations by Apjohn, pyrope contains at least 3 per cent. of yttria.

Fuses with some difficulty before the blowpipe, and with borax yields an emerald-green globule.

OBS. Occurs in the mountains on the south side of Bohemia, imbedded in trap tufa and wacke. A fine blood-red garnet from Greene's creek, Delaware Co., Penn., has been called pyrope, but it has not been analyzed; and no characters have been observed that satisfy us that it belongs to this species.

* Moore's An. Min. p. 156.

HELVIN. CARBUNCULUS HEMIHEDRUS.

Tetrahedral Garnet, *M.* Helvine, *Werner.*

Primary form, the octahedron. *Secondary form:* figs. 30 and 32, Pl. I. *Cleavage* octahedral in traces.

H.=6—6·5. G.=3·1—3·3. *Lustre* vitreous, inclining to resinous. *Streak* white. *Color* wax-yellow, inclining to yellowish-brown, and siskin-green. Subtranslucent. *Fracture* uneven.

Composition, according to Gmelin, (Pogg. iii, 55,)

Silica,	33·258
Protoxyd of iron,	5·561
Protoxyd of manganese,	31·817
Sulphuret of manganese,	14·000
Glucina, Alumina,	12·029
Loss by ignition,	1·155=97·823

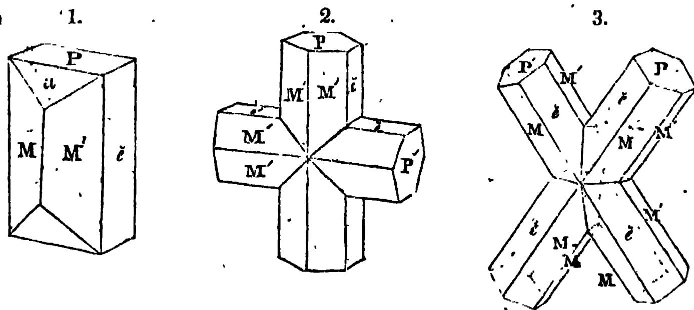
Fuses with effervescence in the reducing flame of the blowpipe, to an opaque globule of almost the same color as the mineral. With borax it forms a diaphanous globule, colored of an amethystine hue by manganese.

OBS. It occurs in gneiss at Schwartzenberg in Saxony, associated with garnet, quartz, fluor, and calc spar. The only other known locality is at Hortekulle, near Modum, in Norway. It was named by Werner in allusion to its yellow color, from ἥλιος, *the sun.*

STAUROTIDE. CARBUNCULUS DECUSSATUS.

Prismatoidal Garnet, *M.* Grenatite. Staurotide, *H.* Staurolith, *W.*

Primary form, a right rhombic prism; M : M=129° 20′. *Secondary forms:*



P : a=124° 38′, M : ĕ=115° 20′ *Cleavage* parallel to ĕ, but interrupted; parallel to M less distinct. Surface P often quite rough and concave. *Compound crystals:* fig. 3 has proceeded from a nucleus composed of four molecules, and is an example of composition parallel to a plane e, on a terminal edge. Fig. 2 represents a compound crystal, in which composition is of the *third* kind, and parallel to a plane on the acute solid angles. These forms are of common occurrence. *Imperfect crystallizations* have not been observed.

H.=7—7·5. G.=3·693, Thomson; 3·724, Haidinger; 3·273, an

opaque and impure specimen, Thomson. *Lustre* subvitreous, inclining to resinous. *Streak* white, or grayish-white. *Color* dark reddish-brown—brownish-black. Translucent—nearly or quite opaque. *Fracture* conchoidal.

Composition, according to Klapfoth, (Beit. v. 80,) Thomson, (Min. i, 280,) and Vauquelin, (J. des M. No. 53,)

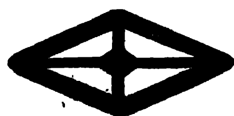
			Brittany.
Silica,	37·50	36·696	33·00
Alumina,	41·00	39·880	44·00
Protoxyd of iron,		18·144	13·00
Protox. of mang.		4·046	Perox. 1·00
Magnesia,		0.686	Lime, 3·84
Moisture,	=97·75, K.	0·080=99·532, T.	=94·84, V.

Before the blowpipe it darkens, but does not fuse.

Obs. It occurs imbedded in mica slate and gneiss, at St. Gothard, in Switzerland; and the Greiner mountain, Tyrol, affords simple crystals of this species, associated with kyanite. Their connection with kyanite is sometimes very peculiar: they occur, apparently, as a continuation of its crystals, and also parallel with them. Twin crystals of a large size occur in Bretagne; also at Oporto and St. Jago de Compostella, &c.

Staurotide is very abundant throughout the mica slate of New England. Franconia, Vt., affords large brownish-red opaque crystals, often presenting compound forms; also a brownish-black variety.

At Windham, Me., near the bridge, the mica slate is filled with large crystals of staurotide; at Mt. Abraham, Hartwell, and Winthrop, Me., are other localities. At Lisbon, N. H., crystals are abundant in mica slate, and on the shores of Mink Pond they are found loose in the soil, from the decomposition of the slate. At Chesterfield, Mass., fine crystals are obtained; also at Bolton, Vernon, Stafford, and Tolland, Conn. Small crystals occur at the Foss ore bed in Dover, Dutchess Co., N. Y.; also in mica slate, three and a half miles from New York city, on the Hudson. Reddish-brown crystals are abundant on the Wichichon, about eight miles from Philadelphia.



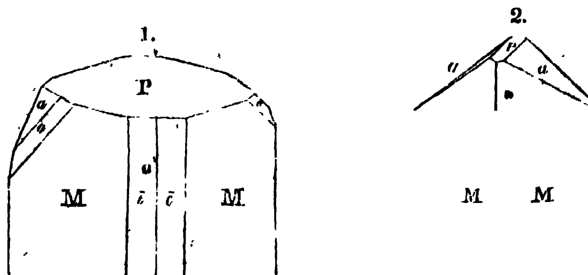
Dr. C. P. Jackson has described a variety of staurotide in tessellated crystals, like chiastolite, from Charlestown, N. H., as represented in the accompanying figure. He states that the staurotide macles pass by insensible shades into andalusite macles, when the micaceous slate passes into argillaceous slate.

The name Staurolite is derived from σταυρος, *a cross*, and λιθος, *a stone*.

ANDALUSITE. Andalusius prismaticus.

Prismatic Andalusite, *M.* Disilicate of Alumina, *Thom.* Feldspath Apyre, *H.* Macle, *H.* Chiastolite. Hohlspath. Crucite. Stanzait. Micaphyllit.

Primary form, a right rhombic prism; M : M=91° 33′, and 88° 27′. The angle varies with the purity of the crystals, and is nearly a right angle in some chiastolites from Lancaster. *Second-*

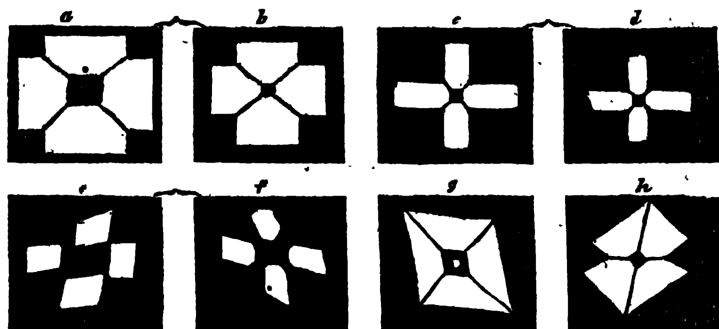


Westford, Mass.

ary forms: ē : ē=128° 6′, M : ē=161° 43′, P : *a*=144° 44′; P : *a*, figure 2, 144° 50′, Teschemacher. *Cleavage* lateral, distinct. *Imperfect crystallizations:* indistinctly columnar and granular.

H.=7·5. G.=3·1—3·32. *Lustre* vitreous. *Streak* white. *Color* flesh red, passing into pearl-gray. Subtranslucent—nearly opaque. *Fracture* uneven. Tough.

The variety chiastolite varies in hardness from 3 to 7·5, owing to impurities. These crystals generally present a tesselated appearance, as if formed by the union of four separate individual crystals, of a grayish-white color, with the borders and interstitial spaces filled with the dark material that composes the gangue. This peculiar structure is exhibited in the following figures,



which are copied from a valuable memoir on this subject, by C. T. Jackson, in the Journal of the Boston Natural History Society, vol. i., p. 55, in which the author proposes the union of the two hitherto distinct species, Andalusite and chiastolite. The same had been previously suggested by F. S. Beudant, (Traité de Min. p. 156, 1824.) The propriety of their union is fully established by Dr. Jackson, from an examination of a large number of specimens, in which he finds an insensible gradation, from those of the lowest degrees of hardness to crystals of the hardness of Andalusite. Moreover, the internal parts of the crystal have an irregularly rhombic form, sufficiently distinct to prove that the supposition is not inconsistent with the crystalline form of Andalusite. The hypothesis of Beudant, to account for these freaks in nature, appears to be the most consistent with the appearances presented, that is, that they are simple crystals, with extraneous matter, regularly arranged by the process of crystallization. This is a common effect of crystallization from a medium containing any impurities mechanically suspended, and it fully accounts for the occurrence. The irregularity of the whitish prisms, in the different parts of the same crystals, (figs. *a* and *b*, are from opposite extremities of the same crystal; so also *c* and *d*, and *e* and *f*,) appear to oppose the hypotheses of the compound nature of these crystals. The chemical constitution of this variety, as determined by Jackson, is sufficient to settle the question of their identity.

Composition, according to Brandes, (Schweig. Journ. xxv, 113,) Bucholz, Thomson, Jackson, and Bunsen, (Pogg. xlvii, 1839,)

	Tyrol.		Tyrol.	*Chiastolite.*	*Andalusite,* Lisenz.	*Chiastolite,* Lancaster.
Silica,	34·000	36·5	35·304	33·0	40·17	39·09
Alumina,	55·750	60·5	60·196	61·0	58·62	58·56
Potash,	2·000	—	—	—	—	—
Perox. iron,	3·375	4·0	1·324	4·0	—	—
Perox. mang.	0·625	—	—	—	0·51	0·53
Lime,	2·125	—	—	—	0·28	0·21
Magnesia,	0·375	—	1·000	—	—	—
Water,	1·000	—	2·032	1·5	—	0·99
	99·250, Br.	101·0, Buch.	100·856, T.	99·5, J.	99·58, Bun.	99·38, Bun.

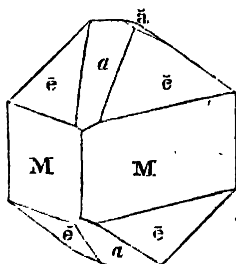
Before the blowpipe, *per se*, it does not melt, but whitens in spots. When pulverized and mixed with borax, it fuses with extreme difficulty to a transparent colorless glass.

OBS. Andalusite occurs only in primitive strata. It was first observed in the province of Andalusia, in Spain. In the Linsenz valley, above Innspruck, in the Tyrol, it occurs in large crystallizations; other foreign localities are Braunsdorf, in Saxony; Galdenstein, in Moravia; in Bavaria; in Siberia; at Botriffney, in Banffshire, in gneiss; at Killiney Bay, Ireland, in mica slate. The chiastolite variety occurs at Jago di Compostella in Spain, Barèges in the Pyrenees, the Bayreuth, and Cumberland, England.

At Westford, Mass., it is found abundantly, both crystalline and massive, and sometimes of a rose color. Litchfield, and Washington, Conn., have afforded fine crystals; also Mt. Abraham, Bangor, and Searsmont, Me. In Pennsylvania, near Leiperville, about a mile and a half from Chester, it occurs in large crystals. Chiastolite is very abundant in the towns of Lancaster and Sterling, Mass., and at the former place occasionally in quartz, presenting all the essential characters of Andalusite. It is met with, also, near Bellows Falls, Vermont; and at Camden in Maine, and Charlestown, N. H.

CHONDRODITE. CHONDRODUS OBLIQUUS.

Hemi-prismatic Chrysolite. *M.* Chondrodite, *Levy.* Condrodite, *H.* Maclurite, *Seybert*, (Silliman's J. v, 336.) Fluosilicate of Magnesia. Brucite, *Amer. Min.*



Orange Co., N. Y.

Primary form, an oblique rhombic prism; M : M=112° 12′? Haüy. *Secondary form*: M : M=112° and 68°, M : ĕ=136°, M : ē=157°, ĕ : ĕ (adjacent)=80°, *a* : *a* (over the summit)=85°, ē ē=89°, ĕ : ē (over *a*)=127°, ă on the edge ĕ ĕ=167°. The annexed figure is drawn from a specimen in the collection of J. A. Clay, Esq., of Philadelphia. The angles were taken with the common goniometer. *Cleavage* indistinct. *Imperfect crystallizations*: structure granular; coarse or fine. H.=6·65. G.=3·118, from New Jersey, Thomson; 3·199, Finland, Haidinger. *Lustre* vitreous—resinous. *Color* yellow, brown, red, apple-green, black. *Streak* white, or slightly yellowish or grayish. Transparent—subtranslucent. *Fracture* subconchoidal—uneven.

Composition, according to Seybert, (Silliman's J. v, 336,) and Rammelsberg, (Pogg. liii, 130,)

	New Jersey.		Yellow, New Jersey.	Yellow, Pargas.
Silica,	32·666		33·06	33·10
Magnesia,	54·000		55·46	56·61
Peroxyd of iron,	2·333	Protoxyd,	3·65	2·35
Potash,	2·108		——	——
Fluoric acid,	4·086	Fluorine,	7·60	8·69
Water,	1·000=96·193, S.		——=99·77, R.	——=100·75, R.

Fuses with extreme difficulty alone before the blowpipe; it loses, however, its color and becomes opaque, and shows traces of fusion on the thinnest edges. With carbonate of soda, on charcoal, it fuses with difficulty to a light gray slag. With borax it fuses easily with some effervescence to a yellowish-green glass. With salt of phosphorus there is a siliceous residue.

OBS. Chondrodite has been found only in granular limestone. Its foreign localities are near Abo, in the parish of Pargas in Finland, and at Aker and Gulsjö in Sweden.

It is found in great abundance in the adjoining counties of Sussex, N. J., and Orange, N. Y., where it is associated with spinel, and occasionally with pyroxene and corundum. At Bryam, orange and straw-colored chondrodite, and also a variety nearly black, occurs

with spinel; at Sparta, a fine locality of honey-yellow chondrodite; a mile to the north of Sparta is the best locality of this mineral in New Jersey. It also occurs at Vernon, Lockwood, and Franklin. Chondrodite is abundant in Warwick, Monroe, Cornwall, near Greenwood Furnace, and at Two Ponds, and elsewhere in Orange Co., N. Y. Fine specimens may be obtained on the land of Mr. Houston, near Edenville. It is obtained also at Chelmsford, Mass., along with scapolite. It occurs sparingly on the bank of Laidlaw lake in Rossie, N. Y.

This mineral was first described and analyzed by Count D'Ohsson, in the Memoirs of the Stockholm Academy, for 1817, p. 206. An American locality was first observed by Dr. Bruce, after whom it has been called Brucite. The name chondrodite is derived from χονδρος, *a grain*, alluding to its granular structure.

HUMITE. Chondrodus rhombicus.

Primary form, a right rhombic prism; M : M=12[illegible]. Occurs in minute and very highly modified crystals, often presenting compound forms. *Cleavage* apparent parallel to M, and ĕ or the shorter diagonal.

H.=6·5—7. G.=3·1—3·2. *Lustre* vitreous. *Streak* white. *Color* various shades of yellow, occasionally almost white, passing into reddish-brown. Transparent—translucent. *Fracture* subconchoidal.

Before the blowpipe it becomes opaque, but is infusible. With borax it forms a transparent glass. According to Rose, it contains fluoric acid.

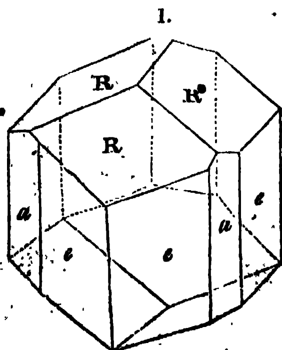
Obs. It occurs among the ejected masses of Monte Somma, associated with mica, pleonaste, and other minerals. Monticelli arranges it under chondrodite.

TOURMALINE. Turmalus rhombohedrus.

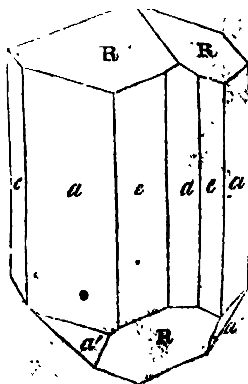
Rhombohedral Tourmaline, *M*. Schorl. Rubellite. Indicolite. Aphrizite. Aphrite, *W*. Turmalin. Tourmaline Apyre, *H*.

Primary form, an obtuse rhombohedron; R : R=133° 26′. *Secondary forms:* fig. 110, Pl. II, also the annexed figures:

1.

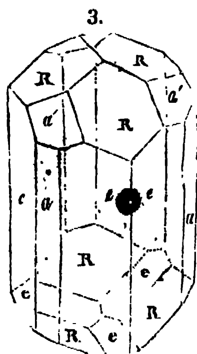


Monroe, Conn.



Haddam, Conn.

R : e=156° 43′, R : a′=141° 40½′, e : e=155° 9′, R : e=113° 17′, e : a=150°, e : e=120°. Crystals often hemihedrally modified, or having dissimilar extremities. *Cleavage* parallel with R and e, difficult. *Imperfect crystallizations:* columnar, coarse or fine, parallel or divergent; granular structure rare.



Gouverneur, N. Y., Newton, N. J.

H.=7—8. G.=3·076, Haidinger; 3·021, a transparent red tourmaline from Paris, Maine, Shepard. *Lustre* vitreous. *Streak* white. *Color* black, brown, blue, green, red, and rarely white; some specimens red internally, and green externally; and others are red at one extremity, and green, blue, or black, at the other; occasionally all these colors appear in the same crystal. Exhibits dichroism; some varieties are red if seen in the direction of the axis, and bluish across it; others liver-brown in one direction and reddish-brown in the other. Transparent—opaque; less transparent across the prism than in the line of the axis. *Fracture* subconchoidal—uneven. Brittle.

Composition, according to Gmelin (Schweig. Jahrb. viii, 514) and Arfvedson, (Afhand. i, 166,)

	Eibenstock. *Black.*	Devonshire. *Black.*	Utön. *Green.*	Rozena. *Red.*	Siberia. *Red.*
Silica,	33·048	35·20	40·30	42·127	39·37
Alumina,	38·235	35·50	40·50	36·430	44·00
Lime,	0·857	0·55	——	1·200	——
Protox. iron,	23·857	17·86	Perox. 4·85	——	——
Magnesia,	——	0·70	——	——	——
Potash,	——	——	——	2·405	1·29
Soda,	3·175	2·09	——	——	——
Boracic acid,	1·890	4·11	1·10	5·744	4·18
Lithia,	——	——	4·30	2·043	2·52
Perox. mang.	——	0·43	1·50	6·320	5·02
Moisture,	——	——	3·60	1·313	1·58
	101·062, G.	96·44, G.	96·15, Arfv.	97·582, G.	97·96,

The action of these varieties before the blowpipe is quite various. In general, they intumesce more or less, some fusing readily, particularly those which contain lime, others assuming a slaggy appearance, without melting, while others, especially the red variety, are not acted on at all. When heated, they exhibit polarity, the most modified extremity becoming positive, and the other negative. In this respect it resembles other hemihedrally modified crystals. At a certain temperature it loses its polarity, but exhibits it again on cooling. Its polarity continues with the decrease of temperature, until it reaches 32° F.; a continued increase of cold re-excites the electric polarity, though with reversed poles. If the excited crystal be broken, each part thus produced will equally possess polarity; and even in the powdered state, it retains its pyro-electricity.

Obs. The different colors presented by this species have given rise to names designating these varieties. Blue tourmalines have been termed *indicolite*, from their indigo-blue color; red tourmalines, *rubellite;* and to the black, the name *schorl* was formerly applied.

Tourmaline is usually found in granite, gneiss or mica slate. It also occurs in dolomite or primitive limestone. Its crystals are frequently very long, and pierce the gangue in every direction. Occasionally they occur short, not longer than broad. The long crystals are seldom perfect at both extremities.

Black tourmalines, of a large size, occur in Greenland, at Hörlberg, near Bodenmais, in Bavaria; at Karinbricka in Sweden; and near Bovey in Devonshire. Small brilliant

crystals are met with, imbedded in decomposed feldspar, at Andreasberg in the Hartz, forming the variety called *Aphrizite.* Rubellite occurs in a species of lithomarge, near Ekatherinenburg in Siberia; pale yellowish brown crystals are found in talc, at Windisch Kappell, in Carinthia; white specimens come from St. Gothard and Siberia.

In the United States, magnificent specimens of red and green tourmalines have been found at Paris, Maine. Some transparent crystals from this locality exceed an inch in diameter, and present a ruby-red color within, surrounded by green; or are red at one extremity, and green at the other. Blue and pink varieties, commonly imbedded in lepidolite, are still to be obtained at this place. Red and green tourmalines occur also at Chesterfield, Mass, in a narrow vein of granite traversing gneiss along with albite, uranite, and pyrochlore. The crystals are commonly small and curved, nearly opaque, and exceedingly frangible. Green crystals often contain distinct prisms of red color, especially when they occur in smoky quartz. Blue tourmalines also occur at this locality. At Goshen, Mass., similar varieties occur, and the blue tourmaline is met with in greater perfection. Norwich, New Braintree, and Carlisle, Mass., afford good black tourmalines; also Alstead, Acworth, and Saddleback Mt., N. H., and Streaked Mountain, Me. Large brownish-black tourmalines in perfect crystals are abundant in steatite at Orford, N. H. Green and black tourmalines are found with beryl and feldspar at Albany, Me. Perfect crystals of a dark brown color occur in mica-slate near Lane's mine, Monroe, Conn. They are sometimes two inches in length and breadth. Haddam, Conn., affords interesting black crystals in mica slate with anthophyllite, in granite with iolite, and at the gneiss quarries. Near Gouverneur, N. Y., light and dark brown tourmalines, often in highly modified crystals, occur with apatite and scapolite in granular limestone; also in simple prisms in the same rock near Port Henry, Essex Co.; also at Schroon, with chondrodite and scapolite. Interesting black crystals are obtained at the chrysoberyl locality near Saratoga, N. Y. At Kingsbridge, N. Y., brown, yellowish or reddish brown crystals occur in dolomite. A grey or bluish-grey and green varieties in three-sided prisms occur near Edenville. Short black crystals are found in the same vicinity, and at Rocky Hill, sometimes five inches in diameter. A mile southwest of Amity, yellow and cinnamon colored crystals occur with spinel in calc spar; also near the same village a clove-brown variety associated with hornblende and rutile in granular limestone. Franklin and Newton, N. J., also afford interesting black and brown tourmalines in limestone associated with spinel. Near New Hope, on the Delaware, large black crystals occur, in which the prismatic faces are very short and sometimes almost obsolete.

Red tourmaline, when transparent, and free from cracks and fissures, admits of a high polish, and forms a rich and costly gem. A specimen from Siberia, presented to Mr. Grenville by the king of Ava, and now in the British museum, was valued at £500 sterling. The yellow tourmaline, from Ceylon, is but little inferior to the real topaz, and is often sold for this gem. The green specimens, when transparent and firm, are also highly esteemed, but the tint of color is commonly dingy. Paris, Me., has afforded splendid gems of both green and red. The Siberian red tourmaline, cut *en cabochon*, exhibits a milk-white chatoyant lustre.

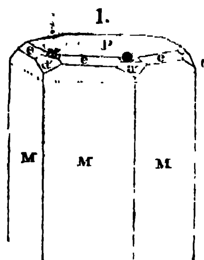
It has been supposed that tourmaline was known to the ancients under the name of *lyncurium*, (λυγκούριον,) which is described as having electrical properties. This name, however, was more probably applied to some variety of amber, which was so called from its supposed origin from the urine of the lynx. The identity of the red tourmaline with the hyacinth of the Greeks, is more probable. The other varieties were either unknown, or possibly united under a common name with other species of the same color. The tourmaline received no attention from the moderns till Lemery, in the year 1717, published his discoveries. The word *tourmaline* is a corruption of the name for this mineral at Ceylon, whence it was first brought into Europe. The name *schorl*, which has been applied to the black tourmalines, and also some other mineral species, is reported to have been derived from Schorlaw, the name of a village in Saxony, which afforded specimens of this variety.

BERYL. BERYLLUS HEXAGONUS.

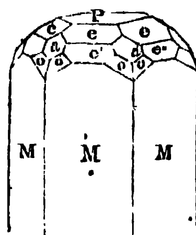
Rhombohedral Emerald, *M.* Beryl. Aquamarine. Smaragd. Emeraude, *H.* Basaltes Hexahedrus *Born.* Davidsonite, *Richardson.* Βηρυλλος. Σμαραγδος.

Primary form, a hexagonal prism. *Secondary forms*: fig. 125, Pl. II, also the annexed figures; M : e=119° 53′, P : e=150° 6′, M : e″=139° 1′, P : e″=130° 59′. *Cleavage* basal; lateral, indistinct.

Imperfect crystallizations: rarely coarse columnar; occasionally large granular.



Haddam, Ct.



Siberia.

H.=7·5—8. G.=2·732, Haidinger, emerald variety; 2·678, an apple green variety. *Lustre* vitreous; sometimes resinous. *Streak* white. *Color* green, passing into light-blue, impure yellow, and white. The brightest of these colors is emerald-green. Transparent—subtranslucent. *Fracture* conchoidal, uneven. Brittle.

Composition, according to Klaproth (Beit. iii, 229 and 219), and Berzelius, (Afhand. iv, 192,)

	Emerald.	*Beryl.*	Broddbo.
Silica,	68·50	66·45	68·35
Alumina,	15·75	16·75	17·60
Glucina,	12·50	15·50	13·13
Oxyd of chromium,	0·30	——	——
Peroxyd of iron,	1·00	0·60	0·72
Oxyd of Columbium,	——	——	0·27
Lime,	0·25=98·30, K.	——=99·30, K.	——=100·07, B.

Transparent varieties become clouded before the blowpipe; at a high temperature the edges are rounded, and ultimately a vesicular scoria is formed. A transparent colorless glass is obtained with borax.

Obs. Emerald and beryl are varieties of the same species, and are distinguished merely by their color; the former including the rich green transparent specimens which owe their color to oxyd of chrome, the latter those of other colors. They were first united in one species by Wallerius. The finest emeralds are found in a vein of dolomite, which traverses a hornblende rock at Muso, near Santa Fé de Bogota, in Grenada. A perfect hexagonal crystal from this locality, two inches long, and about an inch in diameter, is in the cabinet of the Duke of Devonshire. It weighs 8 oz. 18 dwts., and, though containing numerous flaws, and therefore but partially fit for jewelry, has been valued at 150 guineas. A more splendid specimen, though somewhat smaller, it weighing but 6 oz., is in the possession of Mr. Hope, of London. It cost £500. Emeralds of less beauty, but much larger, occur in Siberia. One specimen in the royal collection measures 14½ inches long and 12 broad, and weighs 16¾ pounds troy; another is 7 inches long and 4 broad, and weighs 6 pounds troy. Mount Zalora, in Upper Egypt, affords a less distinct variety, and was the only locality which was known to the ancients. Other localities are Canjargum, in Hindostan, and Salzburg, where it is imbedded in mica slate.

Pliny speaks of the finest beryls as those "qui viriditatem puri maris imitantur,"—*green like the sea*—and crystals of beautiful shades of sky-blue, or mountain-green are hence termed *aqua-marine*. This variety is found in Siberia, Hindostan, and Brazil. In Siberia, they occur in the granite district of Nertschinsk, and in the Uralian and Altai ranges of Siberia. They have been obtained exceeding a foot in length; they are commonly very deeply striated longitudinally. The most splendid specimen of this variety, of which we have any account, belongs to Don Pedro. It approaches in size, and also form, the head of a calf, and exhibits a crystalline structure only on one side: the rest is water-

It weighs 225 ounces troy, or more than 18¾ pounds. The specimen is perfectly transparent, and without a flaw; its color is a fine pale bottle-green. Less clear crystals of beryl occur at the Mourne Mountains, Ireland, county Down; at Cairngorum in Aberdeenshire; at Limoges in France; Finbo and Broddbo in Sweden; Bodenmais and Rabenstein in Bavaria, and elsewhere.

Beryls of gigantic dimensions have been found in the United States. The most remarkable localities are at Acworth, N. H., and Royalston, Mass. One hexagonal prism from the former locality weighed 240 pounds, and measured four feet in length, with the lateral faces 5½ inches across; its color was bluish-green, except a foot at one extremity, which was dull green and yellow. Smaller crystals of a pale yellow color, have been abundant at the same locality, but are now obtained with difficulty. Some specimens have a honey or wax-yellow color. At Royalston, one crystal has been obtained exceeding a foot in length. The smaller prisms are often limpid, and a variety of a yellowish color forms a beautiful gem, resembling chrysolite. The colors are mostly aquamarine, grass-green, and yellowish-green, and the specimens are remarkable for their beauty. The locality is in the southeast part of Royalston, near the school-house, on the land of Mr. Clarke. The best crystals are imbedded in quartz. At Barre, Mass., there is another similar locality, though less remarkable; also at Pearl Hill, in Fitchburg, Goshen, and Chesterfield, Mass. Albany, in Maine, and Norwich, a few miles above Bethel, towards Waterford, afford fine large beryls, with green and black tourmalines; beautiful crystals, often large, are also obtained at Streaked Mountain, with black tourmaline and mica. Bowdoinham and Topham contain other localities of note; the crystals are pale green or yellowish-white, and occur in veins of graphic granite: also, Georgetown, Parker's Island, at the mouth of the Kennebec. Wilmot, N. H., affords fine beryls. Highly interesting crystals, with modified terminations, (fig. 1,) occur at Haddam, Conn., in a feldspar vein in gneiss, on the east side of the river. The crystals are limpid at the extremity for about a twelfth of an inch, as indicated by the dotted line in figure 1. The chrysoberyl locality affords less interesting specimens; and also the Middletown feldspar quarry, and the granite of Chatham, near the cobalt mine. At Monroe, Conn., beryl occurs in a granite vein, and the crystals are often composed of several pieces separated by plates of quartz, (fig. 28, p. 51.) Good crystals, sometimes ten or twelve inches in length, and an inch and a half in diameter, occur with black tourmalines, at Leyperville, Pennsylvania, about a mile and a half from Chester.

The emerald is supposed to derive its color from the presence of a minute quantity of oxyd of chrome, and beryl from oxyd of iron. This species affords some of the most splendid ornaments to the cabinet of the mineralogist. The emerald is among the richest of gems.

EUCLASE. Beryllus rhomboideus.

Prismatic Emerald, *M.* Euclas, *W.* Euclase, *H.*



Primary form, a right rhomboidal prism; M : T=130° 50′ *Secondary form*: *Cleavage* highly perfect parallel to P; less distinct parallel with M and T.

H.=7·5. G.=2·907, Lowry; 3·098, Haidinger. *Lustre* vitreous. *Streak* white. *Color* pale mountain-green, passing into blue and white. Transparent; occasionally subtransparent. *Fracture* conchoidal. Very brittle and fragile.



Composition, according to Berzelius, (K. V. Ac. H. 1819, p. 136,)

Silica,	43·22
Alumina,	30·56
Glucina,	21·78
Peroxyd of iron,	2·22
Oxyd of tin,	0·70=98·48

Strongly heated in the blowpipe flame, it intumesces and becomes white, and melts to a white enamel, if the temperature is still farther increased. It becomes electric by friction, and when once excited, retains this property for several hours. Exhibits double refraction.

Obs. Euclase was originally brought from Peru; it has since been obtained in the mining district of Villa Rica, in Brazil. It is said to occur in chlorite slate, resting on sandstone. According to Prof. Shepard, euclase occurs in thin tabular crystals at the Topaz locality, Trumbull, Conn.

Euclase generally possesses an agreeable and uniform color, and will receive a high polish; but it is useless as an ornamental stone, on account of its brittleness. This property led Hauy to give it the name it bears, from εὖ, *easily*, and κλάω, *to break*.

PHENACITE. Beryllus rhombohedrus.

Rhombohedral Emerald, *M.* Phenakit, *Nordenskiöld*, K. V. Ac. H. 1833, p. 160, and Pogg. xxxi, 57.

Primary form, an obtuse rhombohedron; R : R=115° 25′, according to Nordenskiöld, 116° 40′, according to Beirich. *Secondary forms:* figs. 109 and 111, Pl. II; also the two combined. *Cleavage*, according to Beirich, parallel to the primary faces.

H.=8. G.=2·969, Nord. *Lustre* vitreous. *Colorless*; also, bright wine-yellow, inclining to red. Transparent—opaque. *Fracture* similar to that of quartz.

Composition, according to Hartwall, Silica 55·14, glucina 44·47=99·61, with a trace of magnesia and alumina. Alone before the blowpipe it remains unaltered; but with borax fuses to a transparent glass. With soda it affords a white enamel.

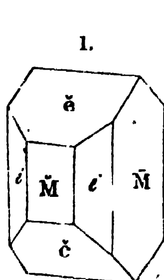
Obs. It occurs with emerald, imbedded in mica slate, in Perm, 85 wersts from Ekatherinenburg; also, accompanied by quartz, in the brown ore of Framont. It was named by Nordenskiöld, its discoverer, from φέναξ, *a deceiver*, in allusion to its having been mistaken for quartz.

CHRYSOBERYL. Sapphirus rectangula.

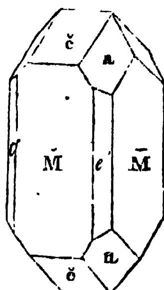
Prismatic Corundum, *M.* Cymophane, *H.* Krisoberil, *W.* Alexandrite.

Primary form, a right rectangular prism. *Secondary forms:*

1.

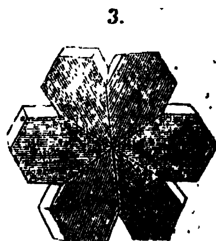


Greenfield, N. Y.



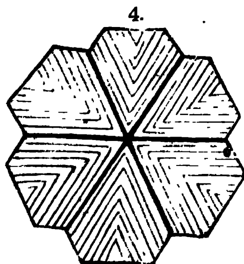
Siberia.

3.



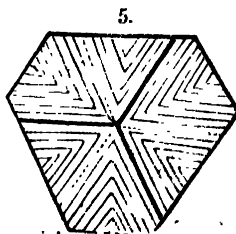
Haddam.

4.



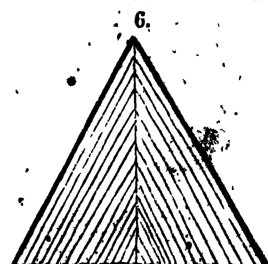
Greenfield, N. Y.

5.



Greenfield, N. Y.

6.



Greenfield, N. Y.

M̆ : ĕ=120° 7′, ĕ : ĕ (adjacent planes)=119° 46′, M̆ : *e*=125° 20′, a : a (adjacent planes)=139° 53′, a : e=133° 8′. *Cleavage* parallel to M̆ ; less distinct parallel to M. *Compound crystals:* figs. 3, 4, 5, 6.

H.=8·5. G.=3·5—3·8 ; 3·597, from Haddam, Conn. ; 3·733, from Brazil ; 3·689, from the Ural, Rose. *Lustre* vitreous. *Streak* white. *Color* asparagus-green, grass-green, emerald-green, greenish-white, and yellowish-green : sometimes raspberry or Columbine red by transmitted light.* Transparent—translucent. It sometimes presents a bluish opalescence internally. *Fracture* conchoidal, uneven.

Composition, according to Seybert, (Silliman's J. viii, 109,) Thomson, (Min. i, 401,) and Damour, (Pogg. lix, 120,)

	Haddam.	Brazil.		Brazil.		Haddam.
Alumina,	73·60	68·666		76·752		75·26
Glucina,	15·80	16·000		17·791		18·46
Silica,	4·00	5·999		——		——
Protoxyd of iron,	3·38	4·733		4·494	Peroxyd,	4·03
Oxyd of Titanium,	1·00	2·666		——		——
Moisture,	0·40	0·666	Volatile Matter,	0·480	Sand,	1·45
	98·18, S.	98·730, S.		99·517, T.		99·20, D.

Alone before the blowpipe unaltered; with soda, the surface is merely rendered dull. With borax, or salt of phosphorus, it fuses with great difficulty.

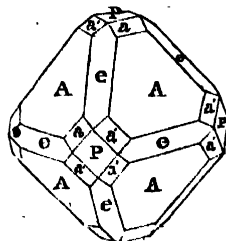
Obs. Chrysoberyl occurs in Brazil, and also Ceylon, in rolled pebbles, in the alluvial deposits of rivers ; also in the Ural in mica slate with beryl and phenacite ; this variety, which is of an emerald-green color and Columbine red by transmitted light, has been called *Alexandrite*. It is supposed to be colored by chrome and to bear the same relation to common chrysoberyl that the emerald does to beryl. At Haddam, Conn., it occurs crystallized, in granite traversing gneiss, and is associated with tourmaline, garnet, beryl, automolite, and Columbite. It is found also in the same rock at Greenfield, near Saratoga, N. Y., accompanied by tourmaline, garnet, and apatite, and numerous interesting figures of crystals have been given by Beck, in his late Report, from which the last three of the above are copied, (p. 376.)

When transparent and free from flaws, and of sufficient size, chrysoberyl is cut with facets, and forms a beautiful yellowish-green gem. If opalescent, it is usually cut *en cabochon*.

Chrysoberyl signifies *golden beryl*, (*χρυσος*, *golden*, *βήρυλλος*, *beryl*,) and was so named in allusion to its color ; it was first established as a distinct species by Werner, (Berg. J. 3 Jahrg. 2 B. 54.) The same name was employed by the ancients for a different mineral, which possibly was chrysoprase. The name *Cymophane*, from *κῦμα*, *wave*, *φαινω*, *to appear*, was applied to this species on account of the peculiar opalescence it sometimes exhibits.

SPINEL. Sapphirus octahedra.

Dodecahedral Corundum, *M.* and *J.* Ceylanite. Pleonaste. Spinelle Ruby. Balas Ruby. Almandine Ruby. Rubicelle. Candite, *Bournon.* Zeilanit, *W.* Alumine Magnésiée or Spinelle, *H.*



Primary form, the regular octahedron. *Secondary forms:* Pl. I, figs. 3, 7, 9, 3+9, 17, 21, and 3+9+17, as in the marginal figure, which represents a crystal from Hamburgh, N. J. *Cleavage* octahedral, though obtained with difficulty. *Compound crystals:* fig. 128, Pl. II ; composition parallel with a face of the octahedron.

H.=8. G. (according to Haidinger)=3·523,

a red transparent variety; 3·575, a black opaque variety called *Ceylanite*. *Lustre* vitreous; splendent—nearly dull. *Streak* white. *Color* red of various shades, passing into blue, green, yellow, brown, and black; occasionally almost white. Transparent—nearly opaque. *Fracture* conchoidal.

Composition, according to Berzelius, Thomson, Abich, Descotils, and Damour, (de Ch. vii, 173, 1843,)

	Blue.	Dark green from U. S.	Black from U. S.	Red.	Pleonaste.	Haddam.
Silica,	5·48	5·620	5·596	2·02	2	0·96
Alumina,	72·25	73·308	61·788	69·01	68	75·53
Magnesia,	14·63	13·632	17·868	26·21	12	17·93
Protox. iron,	4·26	trace	10·564	0·71	16	Perox. 4·06
Lime,	—	7·420	2·804	—	—	—
Water,	—	—	0·980	Protox. chrom. 1·10	—	—
	96·62, Berz.	99·980, Th.	99·600, Th.	99·05, Ab.	98, D.	98·48, Da.

Alone before the blowpipe, infusible; the red varieties change to brown, and even black and opaque as the temperature increases, and on cooling become first green, and then nearly colorless, and at last resume their red color. Fuses with difficulty mingled with borax, but somewhat more readily with salt of phosphorus. The black varieties yield a deep green globule owing to the large amount of iron they contain.

Obs. The specimens of this species have been denominated, according to their colors, as follows; the name *pleonaste* has been applied to the black varieties; *spinelle ruby* to the scarlet colored; *balas ruby* to the rose-red; *rubicelle* to the yellow or orange-red; and *almandine ruby* to the violet colored. The *oriental ruby* belongs to the species sapphire.

Spinel occurs imbedded in granular limestone, and with calcareous spar in serpentine and gneiss. It also occupies the cavities of volcanic rocks.

In Ceylon, Siam, and other eastern countries, it occurs, of beautiful colors, in rolled pebbles in the channel of rivers. The pleonaste variety is found at Candy, in Ceylon, and hence was called *Candite*, by Bournon. At Aker, in Sudermannland, Sweden, it is found of a pale blue and pearl-gray color, in primitive limestone. Small black crystals of splendent lustre occur at Vesuvius, in the ancient scoria of Mount Somma, associated with mica and idocrase: also imbedded in compact Gehlenite, at Monzoni, in the Fassathal.

From Amity, N. Y., to Andover, N. J., a distance of about thirty miles is a region of granular limestone and serpentine, in which, localities of spinel abound. At Amity crystals are occasionally found sixteen inches in diameter; and one, collected by Dr. Heron, weighs forty-nine pounds; it is in three pieces and contains cavities studded with crystals of corundum. They occur of various shades of green, black, brown, and less commonly red, along with chondrodite, and other minerals. A mile southwest of Amity, on J. Layton's farm, is one of the most remarkable localities; also on W. Raynor's farm, a mile to the north; another half a mile north, affording grayish-red octahedrons; and others to the south. Localities are numerous about Warwick, and also at Monroe and Cornwall, though less favorable for exploration than those at Amity. Franklin, N. J., affords crystals of rich shades of black, blue, green, and red, which are sometimes transparent, and a bluish-green ceylanite variety here, has the lustre of polished steel; Newton, N. J., pearl-gray crystals along with blue corundum, tourmaline, and rutile; Bryan, red, brown, green, and black colors, along with chondrodite. At Sterling, Sparta, and Vernon, N. J., are other localities. Light blue spinels occur sparingly in limestone in Antwerp, Jefferson Co., N. Y., two and a half miles south of Oxbow, and in Rossie, two miles north of Somerville, St. Lawrence Co. Green, blue, and occasionally red varieties occur in granular limestone at Bolton, Boxborough, Chelmsford, and Littleton, Mass. Soft octahedral crystals occur in Warwick, which, according to Beck, are spinels permeated with steatite or serpentine, (Min. N. Y., p. 318.) They have been considered pseudomorphs.

A green spinel, from the Schischimskian mountains near Slatoust, has been described by Rose, under the name of *Chlorospinel*. G.=3·591—3·594. Color grass-green.

Composition, according to Rose, (Pogg. l. 653,) Alumina 64·13, magnesia 26·77, peroxyd of iron 8·70, lime 0·27, oxyd of copper 0·27=100·14.

The fine colored spinels, when of large size, are highly esteemed as gems. This species

was first separated from sapphire by Haüy, with which it was confounded by Romé de Lisle and Werner.

AUTOMOLITE. SAPPHIRUS EUTOMA.

Octahedral Corundum, *N.* and *J.* Gahnite, *L.* Spinelle Zincifère, Automolite, *H.*

Primary form, the regular octahedron. *Secondary form*: fig. 21, Pl. I. *Cleavage* octahedral, perfect. *Compound crystals* similar to fig. 129, Pl. II.

H.=7·5—8. G.=4·261, Ekeberg; sometimes contains galena interspersed, and then gives a higher specific gravity. *Lustre* vitreous, inclining to resinous; commonly rather dull. *Streak* white. *Color* dark green, or black. Subtranslucent—opaque.

Composition, according to Ekeberg, (Afhand. i, 84,) and Abich, (Pogg. xxiii, 332,)

		Fahlun.	U. S.
Silica,	4·75	3·84	1·22
Alumina,	60·00	55·14	57·09
Magnesia,	——	5·25	2·22
Oxyd of zinc,	24·25	30·02	34·80
Peroxyd of iron,	9·25=98·25, E.	5·85=100·10, A.	Protox. 4·55

Infusible alone before the blowpipe, and nearly so with borax or salt of phosphorus. With soda it melts imperfectly to a dark colored scoria, which, when fused again with the same reagent, deposits on the charcoal a ring of oxyd of zinc.

Obs. It occurs in talcose slate, at the mines of Nafversberg and Eric Matts, near Fahlun in Sweden, and is associated with galena, blende, garnet, Gadolinite, &c. At Haddam, Conn., it is associated with chrysoberyl, beryl, garnet, and Columbite.

This species was discovered by the celebrated Swedish chemist, Gahn, and was named in consequence Gahnite. It was afterwards named automolite by Haüy, from *αυτομολος, a deserter*, in allusion to the presence of oxyd of zinc in this mineral, although it has no resemblance to an ore.

DYSLUITE. SAPPHIRUS INFUSILIS.

Primary form, the regular octahedron. *Secondary form*: fig. 9, Pl. I. *Cleavage* rather imperfect parallel with the primary faces. Surface rough.

H.=7·5—8. G.=4·551. *Lustre* vitreous, inclining to resinous. *Streak* paler than the color. *Color* yellowish-brown or grayish-brown. Subtranslucent—opaque. *Fracture* conchoidal.

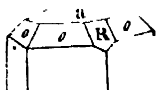
Composition, according to Thomson, (Min. i, 221,) Alumina 30·490, oxyd of zinc 16·80, peroxyd of iron 41·934, protoxyd of manganese 7·6, Silica 2·966, moisture 0·4 =100·19.

Assumes a red color before the blowpipe, which it loses on cooling without any change from its original appearance. Dissolves slowly in borax, and not at all in carbonate of soda or salt of phosphorus. The bead obtained with borax has a deep garnet red color, and is transparent.

Obs. It occurs in small quantity at Sterling, N. J., disseminated through laminated calcareous spar, and associated with Franklinite and Troostite.

SAPPHIRE. SAPPHIRUS RHOMBOHEDRA.

Rhombohedral Corundum, *M.* Corundum. Emery. Oriental Amethyst. Oriental Topaz, Ruby. Emerald, Amethyst. Adamantine Spar. Salemstein. Smirgel. Korund. Demanthspath. Telésie. Corindon. Asteria, *of Pliny*.



Primary form, an acute rhombohedron; R : R =86° 6′. *Secondary form :* R : *e*=136° 57′. R : *o* =154° 1½′, a : *o*=118° 51′, *o* : *e*=151° 9′. *Cleavage* parallel with a, in some varieties, perfect, but interrupted by conchoidal fracture; imperfect commonly in the blue variety. *Imperfect crystallizations :* in layers parallel to R, frequent; granular, often impalpable.



H.=9. G.=3·909—4·16. *Lustre* vitreous; in some specimens inclining to pearly on the plane a. *Streak* white. *Color* blue, red, yellow, brown, gray, and nearly white. The transparent blue varieties possess the highest specific gravity, and the red the least. Several varieties, when cut *en cabochon*, in a direction perpendicular to the axis of the prism, exhibit a bright opalescent star of six rays, corresponding to the hexagonal form of the crystal. Transparent—translucent. *Fracture* conchoidal, uneven. When compact, exceedingly tough.

Sapphire is pure alumina crystallized. The silica that different analyses have appeared to detect in it, has probably been derived from the mortar in which the mineral was abraded. It is unaltered in the blowpipe flame, both alone and with soda; it fuses entirely with borax, though with great difficulty; and also, if pulverized, with salt of phosphorus. It is not attacked by acids. Friction excites electricity, and in polished specimens the electrical attraction continues for a considerable length of time.

OBS. The species sapphire includes corundum and emery, in addition to the finely colored varieties that have always borne this name. Corundum includes the gray and darker colored opaque crystallized specimens; emery, all massive varieties. The *red* sapphire is sometimes called the *Oriental ruby;* the yellow, *topaz;* the green, *emerald;* violet, *amethyst;* and hair-brown, *adamantine spar.*

Sapphire is principally found in the beds of rivers, either in modified hexagonal prisms, or in rolled masses, and is accompanied by grains of magnetic iron ore, and several species of gems. Corundum occurs in crystals, in a rock composed, according to Bournon, of feldspar, fibrolite, and several species of gems; also in dolomite and magnetic iron ore. Adamantine spar occurs in a kind of granite, containing no quartz, associated with magnetic iron ore, and fibrolite. Emery occurs in talcose slate.

The finest ruby sapphires occur in the Capelan mountains, near Syrian, a city of Pegu in the kingdom of Ava; smaller individuals occur near Bilin and Merowitz in Bohemia, and in the sand of the Expaillie river in Auvergne. Blue sapphires are brought from Ceylon; this variety was called *Salamstein* by Werner. Corundum occurs in the Carnatic, on the Malabar coast, in the territories of Ava, and elsewhere in the East Indies; also near Canton, China. At St. Gothard it occurs of a red or blue tinge in dolomite, and near Morzo in Piedmont, in white compact feldspar. Adamantine spar is met with in large coarse hexagonal pyramids on the Malabar coast. Emery is found in large boulders near Smyrna, also at Naxos, and several of the Grecian islands. It occurs in talcose slate at Ochsenkopf, near Schneeberg in Saxony. Its color at this locality is a dark blue, or black, and it looks much like fine grained basalt.

A fine blue variety of sapphire occurs at Newton, N. J., in an aggregate composed of hornblende, mica, feldspar, tourmaline, iron pyrites, talc, and calcareous spar, the whole of which is connected with an extensive bed of granular limestone. It is found more abundantly in detached boulders in the soil, between two small limestone ridges. The

crystals are often several inches long, and when regular, are rhombohedrons or six-sided prisms. Well defined crystals of bluish and pink colors are found in a similar situation at Warwick, N. Y., where they occasionally occupy the cavities of large crystals of spinel. At Amity, N. Y., white, blue, and reddish crystals occur with spinel and rutile in granular limestone. In Pennsylvania, grayish corundum occurs in large crystals in Delaware Co.; also at Newlin in Chester Co. Pale blue crystals are met with at West Farms, Conn., near Litchfield, associated with kyanite. Isolated crystals have been found imbedded in the soil in North Carolina.

The red sapphire is much more highly esteemed than the other varieties of this species. A crystal weighing four carats, perfect in transparency and color, has been valued at half the price of a diamond of the same size. They seldom exceed half an inch in length. Two splendid red crystals, however, having the form of the scalene dodecahedron, and "de la longueur du petit doigt," with a diameter of about an inch, are said to be in the possession of the king of Arracan.

Blue sapphires occur of much larger size. According to Allan, Sir Abram Hume possesses a distinct crystal, which is three inches in length; and in Mr. Hope's collection of precious stones there is one crystal, formerly the property of the Jardin des Plantes, for which he gave £3000 sterling. The sapphire admits of the highest degrees of polish. It is cut by means of diamond dust, and polished on copper or lead wheels with the powder of emery, a massive variety of this species.

Pulverized emery is very extensively employed for cutting and polishing gems and siliceous stones, and also for grinding and burnishing metallic wares.

The word *sapphire* is derived from the Greek, σαπφειρος, the name of a blue stone, highly valued by the ancients. From the description of it, it does not appear to have been the sapphire of the present day, but the lapis lazuli, which more nearly agrees with the character given it by Theophrastus, Pliny, Isidorus, and others. The latter remarks, "Sapphirus cœruleus est cum purpura, habens pulveres aureos sparsos," particles of iron pyrites, which are very frequently disseminated through lapis lazuli, having been mistaken for gold. (Moore's An. Min.) Corundum is a word of Asiatic origin.

SAPPHIRINE.

In small foliated grains. H.=7—8. G.=3·4282, Stromeyer. *Lustre* vitreous. *Color* pale blue, or green. Translucent. *Fracture* subconchoidal.

Composition, according to Stromeyer, (Untersuch., i, 391,) Silica 14·507, alumina 63·106, magnesia 16·848, lime 0·379, protoxyd of iron 3·924, protoxyd of manganese 0·528, loss by ignition 0·492=99·784. Before the blowpipe, both alone and with borax, it is infusible, and is not altered by a strong red heat.

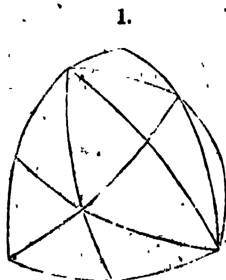
Obs. It is associated with mica and fibrous brown anthophyllite, at Fiskenaes in Greenland, where it was discovered by Giesecké. It was distinguished from sapphire, which it somewhat resembles, by Stromeyer. Kobell places it near spinel.

DIAMOND. Adamas octahedrus.

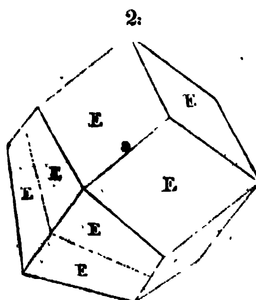
Octahedral Diamond, *M.* Adamant. Demant, *W.* Diamant, *L.* and *H.* Ἀδάμας.

Primary form, the regular octahedron. *Secondary forms*: figs. 3, 5, 6, 7, 8, 9, 20, 41, Pl. I. The faces are very often curved,

1.

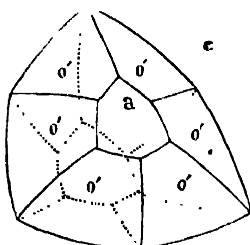


2.



as in figure 1, which is the same form represented with straight edges in fig. 41. *Cleavage* highly perfect parallel to the primary faces. *Compound crystals:* fig. 129, Pl. II; composition parallel to the face of the octahedron. Also the annexed figure, in which composition is of the same kind, (that is, parallel to the face of the octahedron;) but the crystal is shortened in the direction of an octahedral axis.

3.



H.=10. G.=3·5295, Thomson; 3·488, Lowry. *Lustre* brilliant adamantine. *Streak* white. *Color* white—colorless; occasionally tinged yellow, red, orange, green, brown, or black. Transparent; translucent when dark colored. *Fracture* conchoidal.

The diamond is pure carbon crystallized. It burns, and is wholly consumed at a temperature of 14° Wedgwood, producing carbonic acid gas. It is not acted on by acids or alkalies. Exhibits vitreous electricity when rubbed. Some specimens, exposed to the light of the sun for a short time, give out light when carried into a dark place. It possesses the power of refracting light to a very high degree.

OBS. It is as yet uncertain what rock is the original repository of this precious stone. It has been found in India in a species of conglomerate, composed of rounded siliceous pebbles, quartz, chalcedony, &c., cemented by a kind of ferruginous clay; and in Brazil, in a similar situation. Diamonds are usually, however, washed out from loose alluvial soil. It has been of late discovered, that diamonds occur in the Uralian mountains, and M. Parrot describes them (Mem. de l' Ac. Imp. de St. Petersbourg, iii, 21, 1835) as presenting the form represented in fig. 20. Two that he examined contained small black uncrystallized particles in fissures, which he supposes to be vegetable carbon. This rather favors the hypothesis of their vegetable origin. Dr. Brewster was led by the effects of the diamond in polarizing light, the cavities it often contains, and the nature of its matrix in India and elsewhere, to advance this opinion in the London and Edinburgh Journal, October, 1835, in which he supposes, "that the diamond originates like amber from the consolidation of, perhaps, vegetable matter, which gradually acquires a crystalline form, from the influence of time and the slow action of corpuscular forces." According to M. Denis (Ann. des M. 3d ser. xix, 602) the diamond in Minas Geraes, Brazil, belongs to a talcose formation consisting of talc and quartz called itacolumite, the same that affords the topaz and much of the gold of that district. It is found in two different deposits; one, called gurgulho, consists of broken quartz, and is covered by a thin bed of sand or earth; the other, cascalho, of *rolled* quartz pebbles united by a ferruginous clay, resting usually on talcose clays, the whole, the debris from talcose rocks. The first deposit affords the finest diamonds, and both contain also gold, platinum, magnetic iron, rutile, &c.

In India, the diamond is met with in the district between Golconda and Masulipatam; near Panna in Bundelcund, where some of the most magnificent specimens have been found; also on the Mahanuddy near Ellore. The locality on the island of Borneo, is at Pontiana. In Brazil, the diamond grounds are comprised within the district of Minas Geraes. The river Gunil, in the province of Constantine in Africa, is reported to have afforded some diamonds. The diamond has not hitherto been found in the United States. The late report of the discovery of one in North Carolina, weighing one and a half carats, requires confirmation.

The largest diamond of which we have any knowledge is mentioned by Tavernier, as in possession of the Great Mogul. It weighed originally, 900 carats, or 2769·3 grains, but was reduced by cutting to 861 grains. It has the form and size of half a hen's egg. It was found in 1550, in the mine of Colone. The diamond, which formed the eye of a Brahminical idol and was purchased by the Empress Catharine II, of Russia, from a French grenadier, who had stolen it, weighs 193 carats, and is as large as a pigeon's egg. The Pitt or regent diamond is of less size, it weighing but 136·25 carats or 419¼ grains,

but on account of its unblemished transparency and color, it is considered the most splendid of Indian diamonds. It was sold to the Duke of Orleans, by Mr. Pitt, an English gentleman, who was governor of Bencoolen in Sumatra, for £130,000. It is cut in the form of a brilliant, and is estimated at £125,000. Napoleon placed it in the hilt of his sword of state. The Rajah of Mattan has in his possession a diamond from Borneo, weighing 367 carats. The mines of Brazil were not known to afford diamonds, till the commencement of the 18th century. The crystals they yield are seldom large. Maure mentions one of 120 carats, but they rarely exceed 18 or 20. The famous diamond, weighing 1680 carats, belonging to the Emperor of Brazil, is supposed to be a topaz.

Colorless diamonds are the most highly esteemed. When cut and polished, a diamond weighing one carat is valued at £8; and the value of others is calculated by multiplying the square of the weight in carats by 8. The value of large diamonds increases, however, at a much more rapid rate. The grinding and cutting of diamonds is done entirely by the hand, and is accomplished mostly by the mutual friction of two specimens, assisted by the powder of the diamond. This method was first discovered in 1456, by Louis Berquen, a citizen of Bruges. Previous to his time, the diamond was known only in its native uncut state.

The diamond, besides its use as an ornament, is exceedingly valuable for the purposes of engraving and cutting glass. The curvature of the crystalline faces much improves it for this purpose. The edges obtained by cleavage, or formed by the lapidary, are comparatively quite ineffectual in their cutting powers, and are never set for the glazier.

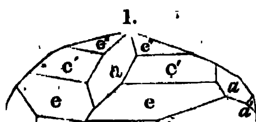
The term *Adamant*, Gr. ἀδαμας, (of which the word *diamond* is probably a corruption,) is supposed to be derived from Greek ἀ privative, and δαμάω, *to subdue*, as if invincible by fire. This name was applied by the ancients to several minerals differing much in their physical qualities. A few of these are quartz, specular iron ore, emery, and other substances of rather high degrees of hardness, which cannot now be identified. It is doubtful whether Pliny had any acquaintance with the real diamond.

TOPAZ. Topazius rhombicus.

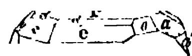
Prismatic Topaz, *M.* and *J.* Fluosilicate of Alumina, *Thom.* Physalite, Pyrophysalite, *Hisinger.* Pycnite. Schorlous Beryl. Schorlite. Schorlartiger Beril, *W.* Silice Fluatée Alumineuse, Alumine Fluatée Siliceuse, *H.*

Primary form, a right rhombic prism: M : M=124° 19′. *Secondary forms:*

1.



M M



M M

Schneckenstein.

M : ė=164° 24½′, *e* : *e* (adjacent planes)=86° 52′, M : e=135° 27½′, e : e=141° 7′, M : e′=124° 7′, M : e″=116° 56′, e″ : e″=155° 37′, P : *a*=136° 29′, P : *a′*=117° 47′, *c′* : *o*=131° 4′, P : *o*=138° 56′. *Cleavage* parallel to P highly perfect. *Imperfect crystallizations:* structure columnar—particles thin, long, and slightly coherent—

lateral surfaces longitudinally striated; granular—particles of various sizes.

H.=8. G.=3·4—3·65. *Lustre* vitreous. *Streak* white. *Color* yellow, white, green, blue; pale. Transparent—subtranslucent. *Fracture* subconchoidal, uneven.

Composition, according to Berzelius, (Afhandlingar, iv, 236,)

	Saxon Topaz.	Pyrophysalite.	Pycnite.
Silica,	34·24	34·36	38·43
Alumina,	57·45	57·74	51·00
Fluoric acid,	7·75=99·44	7·77=99·87	8·84=98·27

It is infusible alone, on charcoal, before the blowpipe, but when strongly heated, the faces of crystallization are covered with small blisters, which crack as soon as formed. Some varieties assume a wine-yellow or pink tinge when heated. With borax it slowly forms a diaphanous glass. When pulverized, it changes to green the blue solution of violets. Most topazes become electric by heat, and, if both terminations are perfect, exhibit polarity; the transparent varieties are easily rendered electric by friction.

OBS. Pycnite has been separated from this species, but differs from topaz mainly in its columnar structure. The *physalite* or *pyrophysalite* of Hisinger is a coarse, nearly opaque variety, found in yellowish-white crystals of considerable dimensions. The variety intumesces when heated, and hence its name from φυσαω, *to blow*.

Topaz commonly occurs in granite, associated with tourmaline and beryl, occasionally with apatite, fluor spar, and tin: also in talcose rock, as in Brazil. With quartz, tourmaline, and lithomarge, it forms the aggregate called topaz rock by Werner.

Fine topazes are brought from the Uralian and Altai mountains, Siberia, and from Kamschatka, where they occur of green and blue colors. In Brazil they are found of a deep yellow color, either in veins or nests in lithomarge, or in loose crystals or pebbles. Magnificent crystals of a sky-blue color have been obtained in the district of Cairngorum in Aberdeenshire. Jameson mentions a crystal from this locality, which weighed nineteen ounces. The tin mines of Schlaggenwald, Zinnwald, and Ehrenfriedersdorf in Bohemia, St. Michael's Mount in Cornwall, &c., afford smaller crystals. In the Mourne mountains it occurs in small limpid crystals, associated with beryl, albite, and mica, in the drusy cavities of granite. The physalite variety occurs in crystals of immense size, at Finbo, Sweden, in a granite quarry, and at Broddbo in a boulder. A well-defined crystal from this locality, in the possession of the College of Mines of Stockholm, weighs eighty pounds. Altenberg in Saxony is the principal locality of pycnite. It is there associated with quartz and mica.

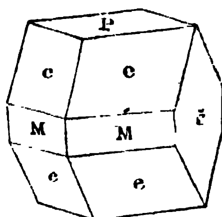
Trumbull and Middletown, Conn., are the only known localities of this species in the United States. At Trumbull the crystals are abundant, but are seldom transparent, except those of very small size. These are usually white; occasionally with a tinge of green or yellow. The large coarse crystals sometimes attain a diameter of several inches, (rarely six or seven,) but they are deficient in lustre, usually of a dull yellow color, though occasionally white, and often are nearly opaque. They sometimes present a few terminating planes of crystallization, in addition to the lateral faces. They are associated with magnetic pyrites, mica, and chlorophane; also rarely with wolfram and tungstate of lime.

Topaz is employed in jewelry, either with its natural yellow color, or altered by heat. The variety from Brazil, when heated, assumes a pink or red hue, so nearly resembling the Balas ruby, that it can be distinguished only by the facility with which it becomes electric by friction. The finest crystals for the lapidary are brought from Minas Novas in Brazil. From their peculiar limpidity, they are sometimes denominated *goutte d'eau*, and when cut with facets and set in rings, they are easily mistaken, by daylight, for diamonds. The coarse varieties of topaz may be employed as a substitute for emery in grinding and polishing hard substances.

The ancient τοπαζιον was found on an island in the Red Sea, which was often surrounded with fog, and therefore difficult to find. It was hence named from τοπαζω, *to seek*. This name, like most of the mineralogical terms of the ancients, was applied to several distinct species. Pliny describes a statue of Arsinoe, the wife of Ptolemy Philadelphus, four cubits high, which was made of τοπαζιον, or topaz, but obviously not the topaz of the present day, nor chrysolite, which has been supposed to be the ancient topaz. It has been conjectured that it was a jasper or agate; others have imagined it to be prase, or chrysoprase, (Moore's An. Min.)

FORSTERITE. TOPAZIUS VESUVIANUS.

Levy. Ann. Phil. 2d series, vii, 61.



Primary form, a right rhombic prism; M : M=128° 54′. *Secondary form :* M : e=143° 54′, P : e=126° 6′, e : e (adjacent planes)=139° 14′, e : ē=110° 23′. *Cleavage :* basal, perfect, and easily obtained.

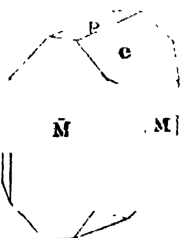
Scratches quartz. *Lustre* vitreous, splendent. *Streak* white. *Colorless.* Translucent.

According to Children, it contains silica and magnesia.

OBS. This species was first noticed by Levy in small crystals, accompanying spinel and olive-green pyroxene, on Mount Vesuvius. Its angles are nearly identical with those of chrysoberyl, but its cleavage parallel with P is quite peculiar.

CHRYSOLITE. CHRYSOLUS RECTANGULUS.

Prismatic Chrysolite, *M.* and *J.* Anhydrous Silicate of magnesia, *Thom.* Peridot, *H.* Olivine. Chusite, Limbelite, *Saussure.* Krisolith, *W.*



Primary form, a right rectangular prism. *Secondary form :* P : ĕ=130° 27′, M̆ : ĕ=139° 33′, ĕ : ĕ=99° 7′, M̆ : e =155° 5′, e : e=130° 10′. M̆ : e=114° 55′. *Cleavage* perfect parallel with M̆. *Imperfect crystallizations :* structure coarse or fine granular—aggregated in irregular spheroidal masses, imbedded in rocks.

H.=6·5—7. G.=3·33—3·5 ; 3·441 of chrysolite, Haidinger ; 3·3386—3·3445, (olivine,) Stromeyer ; 3·3514, (chrysolite,) Stromeyer. *Lustre* vitreous. *Streak* white. *Color* green, of various shades, commonly olive green ; sometimes inclining to brown. Transparent—translucent. *Fracture* conchoidal.

Composition, according to Stromeyer (Pogg. iv, 194) and Walmstedt, (K. V. Ac. H., 1824, p. 259,)

	Chrysolite.	Olivine.	Olivine.	Olivine
Silica,	39·73	40·09	38·48	40·83
Magnesia,	50·13	50·49	48·42	47·74
Protox. iron,	9·19	8·17	11·19	11·53
Oxyd of nickel,	0·32	0·37	——	——
Oxyd of manganese,	0·09	0·20	0·34	0·29
Alumina,	0·22	0·19	0·18	trace
	99·68, S.	99·51, S.	98·61, S.	100·39, W.

The two last are analyses of olivine from Siberian meteoric iron.

Before the blowpipe chrysolite becomes somewhat darker, but does not fuse, nor lose its transparency. With borax it forms a green transparent glass. The color of olivine is removed by nitric acid, the acid separating the iron, its coloring ingredient. It exhibits double refraction.

OBS. Crystallized specimens which present bright colors and high degrees of transparency, have been called pre-eminently *chrysolite*, while imbedded masses, less crystalline in their structure, and inferior in transparency and brightness of color, have distinguished by the name *olivine*.

The perfectly crystallized chrysolite is brought from Constantinople: its locality is not known. Less distinct crystallizations occur imbedded in lava, at Vesuvius and the Isle of Bournon; imbedded in obsidian, at Real del Monte in Mexico; among sand at Expaillie in Auvergne, in pale green transparent crystals. Olivine is more abundant, being of frequent occurrence in basalt and lavas. Crystals, several inches in length, occur in greenstone at Unkel, on the Rhine; spheroidal masses are met with at Kapfenstein in Lower Styria; and at Hecla and Vesuvius. Olivine is common in the lavas and basalt of the Sandwich and other Pacific Islands. It is a frequent ingredient of meteoric stones.

Olivine is commonly very fragile and often filled with cavities, and is therefore unfit for an ornamental stone. Chrysolite, also, is usually too much intersected by flaws to be valued as a gem, and is so soft as to require the greatest care to retain its polish.

The minerals *Chusite* and *Limbelite* of Saussure, from the volcanic district of Limbourg, appear to be decomposed varieties of this species. In the first stages of decomposition chrysolite becomes iridescent; it afterwards turns red and opaque, from the development of the iron it contains.

Hyalosiderite is also commonly considered a variety of this species. According to Walchner, it occurs in crystals of a yellowish or reddish-brown color in amygdaloid, in the Kaiserstuhl, near Sasbach, in Brisgau. Its crystals are flat rectangular tables, with the terminal edges deeply replaced, ĕ : ĕ=99° 22′, ĕ : ĕ=77° 50′. Its streak is cinnamon-brown; internal lustre vitreous, external submetallic; subtranslucent. H.=5·5. G.=2·875. *Composition*, according to Walchner, Silica 31·634, protoxyd of iron 28·488, magnesia 32·403, alumina 2·211, peroxyd of manganese 0·480, potash 2·788, and chromium a trace=98·004. Before the blowpipe it becomes black, and then melts to a black bead, which is attracted by the magnet. It was discovered by Walchner, (Schweigger's Jahrbuch, xxxix, 65, 1823.) The name is derived from ὑαλος, *glass*, and σιδηρος, *iron*.

The word *chrysolite* is derived from χρυσος, *gold*, and λιθος, *stone*, in allusion to its color.

LIGURITE. CHRYSOLITUS OBLIQUUS.

Primary form, an oblique rhombic prism. M : M=140°.

H. above 5. G.=3·49. *Lustre* of the surface of fracture, between vitreous and resinous. *Streak* grayish-white. *Color* apple-green, sometimes speckled internally. Transparent—translucent. *Fracture* uneven.

Composition, according to Viviani, Silica 57·45, alumina 7·36, lime 25·30, magnesia 2·56, oxyd of iron 3, oxyd of manganese 0·5=96·17.

OBS. It occurs in a talcose rock, on the banks of the Stura, in the Apennines of Liguria. It does not become electric by heat, nor by friction.

It is considered a superior gem to chrysolite, both in color, hardness, and transparency.

TAUTOLITE.

Philosophical Magazine, new series, iii, 398.

Primary form, according to Mohs, trimetric. *Cleavage* only in traces.

H.=6·5—7. G.=3·865. *Lustre* vitreous. *Streak* gray. *Color* velvet-black. Opaque. *Fracture* conchoidal, uneven. Very brittle.

Before the blowpipe it fuses to a black scoria, attractable by the magnet; with borax it forms a clear green glass. These and other reactions evince that the mineral contains silica, protoxyd of iron, magnesia, and alumina.

OBS Occurs in volcanic feldspathic rocks, in the vicinity of the Lanchen See, near Bonn, on the Rhine. It was distinguished by Breithaupt.

PERICLASE. PERICLASUS CUBICUS.

Periklas, *Scacchi*, Mem. Min. Naples; *Damour*, Ann. des Mines, 4th ser., iii, 369.

Primary form, the cube. *Secondary form*, the regular octahedron. Cleavage cubic, perfect.

H. nearly that of feldspar. G.=3·75. *Lustre* vitreous. *Color* greenish. Translucent.

Composition, according to Scacchi and Damour,

Magnesia,	89·04	92·57	91·18
Protoxyd of iron,	8·56	6·91	6·30
Loss,	2·40=100, S	Insol matters, 0·86 100·37, D	2·10=99·58, D

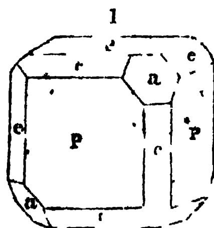
Rammelsberg considers it pure Magnesia. Before the blowpipe, infusible. When pulverized, soluble entirely in the acids.

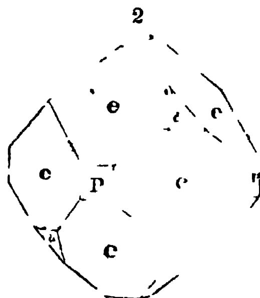
OBS. This species occurs in the calcareous blocks of Mount Somma, Italy, in small glassy transparent crystals, presenting the form of the regular octahedron.

BORACITE. BORACITUS HEMIHEDRUS.

Tetrahedral Boracite, *M.* Octahedral Boracite, *J.* Borate of Magnesia, *P.* Biborate of Magnesia, *Thom.* Borazit, Magnésie Boratée, *H.* Calcareus Boracites, *Wern.*

Primary form, the regular octahedron. *Secondary forms*: figs. 28 and 33, Pl. I; also the annexed figures:





Cleavage in traces parallel to the faces of the octahedron.

H.=7. G.=2·971, Haidinger. *Lustre* vitreous, inclining to adamantine. *Streak* white. *Color* white, inclining to gray, yellow, and green. Subtransparent—translucent. *Fracture* conchoidal, uneven. Pyro-electric.

[Compos]*ition*, according to Stromeyer, (Gilbert's Annalen, xlviii, 215,) Arfvedson, (K. V. Ac. H., 1822, p. 92,) and Rammelsberg, (Pogg. xlix, 445.)

Boracic acid,	67	69·7	69·252
Magnesia,	33=100, St	30·3=100, Arf.	30·748=100, Ram

... before the blowpipe, and forms a glassy globule, which becomes crystalline, ... and white, on cooling. Heat excites four sets of electrical poles, the four most ...ly modified angles becoming positive, and the diagonally opposite negative.

...

Boracite has been observed at only two localities, and in each is imbedded in

gypsum, [illegible]ciated with anhydrite. These localities are at Kalkberg near Luneberg and Segeberg near Kiel in the dutchy of Holstein. At the former place it is also associated with common salt. It has been observed only in crystals, and these are always hemihedrally modified.

RHODIZITE. BORACIUS RUBEFACIENS.

G. Rose, Poggendorf's Annalen, xxxiii, 253.

Primary form, monometric. *Secondary forms*: hemihedral like boracite, planes a smooth and shining; e with less lustre and often uneven.

Hardness sufficient to resist the action of the knife. *Lustre* vitreous, passing into adamantine, splendent. *Color* grayish or yellowish white. Translucent. Pyro-electric.

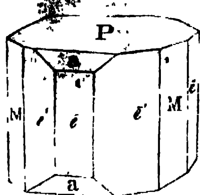
Before the blowpipe, held in the platinum forceps, it fuses on the edges to a white opaque glass, tinging the flame at first green; then green below and red above, and finally red throughout. With borax and salt of phosphorus, it fuses to a transparent glass, and appears to contain no silica. Dissolves with great difficulty in muriatic acid. Resembles boracite in its pyro-electric qualities.

On account of the reactions of this species before the blowpipe, and also from its external characters, rhodozite is supposed to be closely allied to boracite, and is considered a lime-boracite.

OBS. This species was discovered by M. G. Rose, in very minute crystals on some of the red tourmalines of Siberia, and was named from 'ροδιζειν, *to have the color of the rose*, in allusion to its tinging flame red. The largest crystals seen were two lines in diameter.

IOLITE. HYALUS BICOLOR.

Prismatic Quartz, *M*. Dichroite. Peliom. Steinheilite. Cordierite, *H*. Sapphire d'eau. Hard Fahlunite.



Primary form, a rhombic prism; M : M = 120°. *Secondary form*: M : e = 150°, M : ē = 120°. *Cleavage* parallel to P and e, indistinct. *Imperfect crystallizations*: structure granular, strongly coherent; particles distinguished with difficulty.

H. = 7—7·5. G. = 2·5969, a Greenland specimen, Stromeyer; 2·651—2·6643, from Haddam, Conn., Thomson. *Lustre* vitreous. *Streak* white. *Color* various shades of blue, generally inclining to black; often deep blue, if viewed in the direction of the vertical axis, and brownish-yellow, or yellowish-gray, perpendicular to it. Transparent—translucent. *Fracture* subconchoidal.

Composition, according to Stromeyer, (Untersuch., p. 329,) Thomson, (Min. i, 278,) and Jackson, (communicated to the author,)

	Greenland.	*Peliom*, Bodenmais.	*Steinheilite*.	Haddam.	Unity, N.H.
Silica,	49·170	48·352	48·525	48·35	48·15
Alumina,	33·106	31·706	31·502	32·50	32·50
Magnesia,	11·454	10·157	15·000	10·00	10·14
Protoxyd of iron,	4·338	8·316	1·610	6·00	7·92
Prot. manganese,	0·037	0·333	0·243	0·10	0·28
Water,	1·204	0·595	1·705	3·10	0·50
	99·309, S.	99·459, S.	98·585, T.	100·05, J.	99·49, J

At a high heat before the blowpipe, it fuses on the edges to a blue translucent glass; with borax it slowly forms a clear bead. Not acted on by acids.

Obs. Iolite is met with at Bodenmais, in Bavaria, occasionally in perfect crystallizations, but usually massive. It is associated with magnetic pyrites. The variety from this locality has been called *peliom*, from its peculiar smoky-blue color, from πελιος. It occurs in quartz, at Ujordlersoak, in Greenland; in granite, at Cape de Gata, in Spain; at Arendal, in Norway; at Orijervi, in Finland; at Tunaberg, in Sweden, &c. Ceylon affords a transparent variety, in small rolled masses, of an intense blue color.

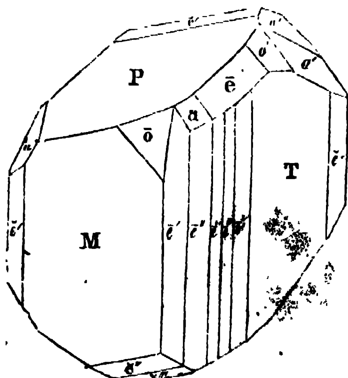
At Haddam, Conn., it is associated with garnet and anthophyllite in gneiss; also in quartz with garnet and yellowish-green feldspar, near the Norwich and Worcester Railway, between the Shetucket and Quinnebaug, where the gneiss has been quarried for the road; it is abundant in large massive individuals. At Brimfield, Mass., on the road leading to Warren, near Sam. Patrick's, it is associated with adularia, in gneiss; occurs also in beautiful specimens at Richmond, N. H., in talcose rock along with anthophyllite.

It is occasionally employed as an ornamental stone, and when cut, exhibits different colors in different directions.

The name *iolite* is derived from ιον, *a violet*, and λιθος, *stone*, in allusion to its color. From its property of exhibiting different colors, when viewed in different directions, it has been named *dichroite*, from δις, *double*, and χρόα, *color*.

AXINITE. Hyalus acutus.

Prismatic Axinite, *M.* Thummerstein. Thumite. Yanolite.



Primary form, an oblique rhomboidal prism; P : M=134° 40′, P : T=115° 5′, M : T=135° 10′. *Secondary form:* M : ĕ′=179° 20′, M : ă″=174° 40′, P : ē=143° 20′, P : ō=133° 25′, P : *a*′=121° 30′, T : ĕ′=147° 55′, M : ĕ″=135° 12′. *Cleavage* indistinct and interrupted. *Imperfect crystallizations:* structure lamellar, lamellæ commonly a little curved; a granular structure is occasionally observed.

H.=6·5—7. G.=3·271, Haidinger; a Cornish specimen. *Lustre* highly vitreous. *Streak* white. *Color* clove-brown, inclining to plum-blue and pearl-gray; occasionally green, from an admixture of chlorite; presents different colors viewed in two different directions. Transparent—subtranslucent. *Fracture* conchoidal. Brittle. Pyro-electric.

Composition, according to Vauquelin, (J. des Mines, xxiii, 1,) Wiegmann, (Schweig. xxxii, 462,) and Rammelsberg, (Pogg. l, 367,)

	Dauphiné.	Hartz.	Hartz.
Silica,	44	45·00	43·676
Alumina,	18	19·00	15·630
Lime,	19	12·50	20·671
Magnesia,	—	0·25	1·703
Peroxyd of iron,	14	12·25	9·454
Peroxyd of manganese,	4	9·00	3·048
Potash,	—	——	0·637
Boracic acid,	——=99, V.	2·00=100·00, W.	5·609=100·428, R.

Fuses readily before the blowpipe with intumescence, to a dark-green glass, which becomes black in the o[illegible]ng flame.

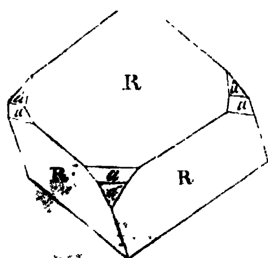
Obs. [illegible] occurs in large clove-brown crystals, remarkable for the brilliancy of their lustre and perfection of form, at St. Cristophe near Bo[illegible] Oisans in Dauphiny, where it is associated with albite, Prehnite, and quartz. Th[illegible] mines traversing mica-slate at Kongsberg afford smaller crystals. It also occurs [illegible] hornblende, or magnetic iron ore at Nordmark in Sweden, and in rather complex crystals of a dark color, at Botallack in Cornwall; at this place it also occurs massive, forming a peculiar kind of rock with garnet and tourmaline. It is also met with at Thum near Ehrenfriedersdorf in Saxony, and has hence been called *Thumite* and *Thummerstein*. Axinite was so called by Karsten, on account of the acuteness of the edges of its crystals, or their resemblance to an axe or hatchet, from ἀξίνη, *an axe*. Axinite has been found by Jackson at Phippsburg, in Maine, associated with yellow garnet and idocrase.

Axinite admits of a high polish, but is deficient in delicacy of color.

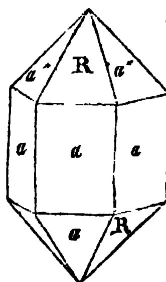
QUARTZ. Hyalus rhombohedrus.

Rhombohedral quartz, *M.* Flint. Silex. Chalcedony. Cacholong. Agate. Jasper. Hornstone. Cat's Eye. Amethyst. False Topaz. Rose Quartz. Prase. Chrysoprase. Cantalite. Iron Flint. Heliotrope. Eisenkiesel. Berg-crystal. Kalzedon.

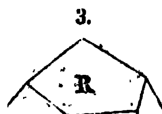
Primary form, an obtuse rhombohedron; R : R=94° 15′. *Secondary forms:* fig. 124, Pl. II, from Gouverneur, New York; also the annexed figures:

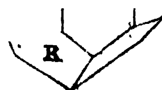


Chesterfield, Mass



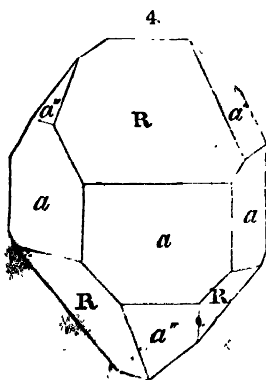
3.



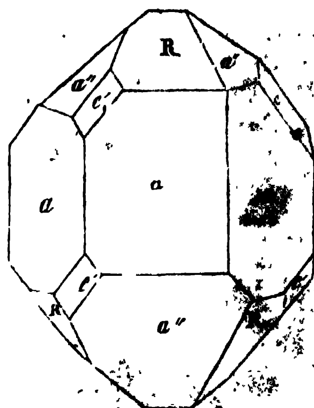


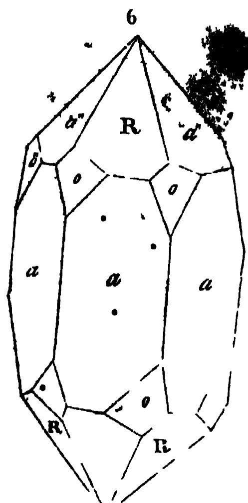
Compostella, Spain.

4.

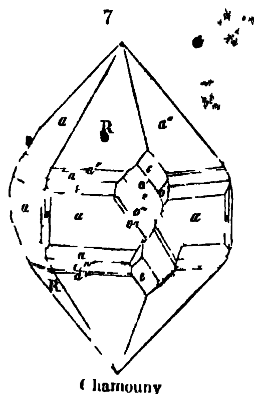


Fairfield, N. Y.

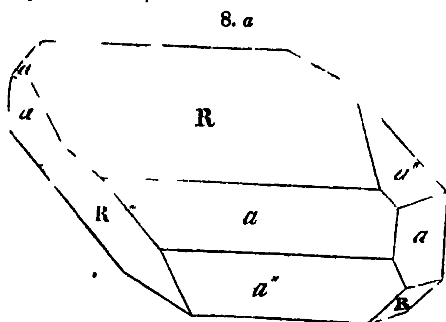




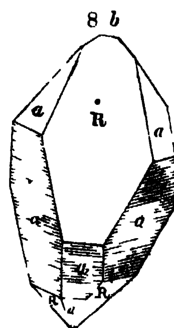
White Mts, N H

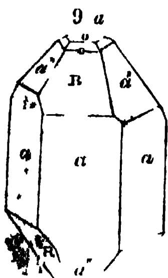


Chamouny

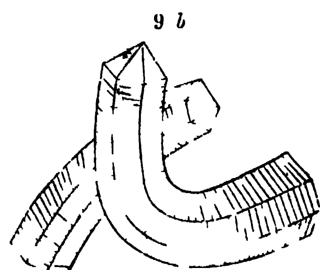


Fairfield, N Y

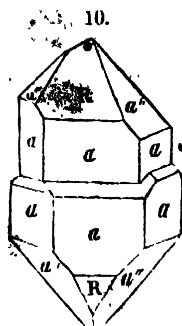




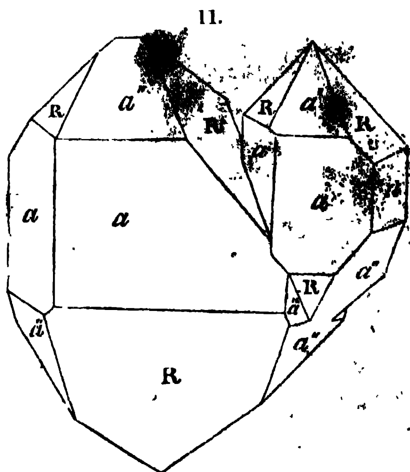
Herkimer Co N Y



R : a=141° 17′, R : a''=133° 44′, R : o=151° 5′, R : o''' (fig.7,)= 148° 40′. In fig. 9 a, R : o=145° 22′, back face of the pyramid on o 111° 15′, R : o′ 165° 30′, Shepard. *Cleavage* very indistinct, parallel to R and a. Sometimes obtainable by plunging a heated crystal into cold water. *Compound crystals*.



Fairfield, N. Y.



Fairfield, N. Y.

These are instances of postnatal composition; they are of frequent occurrence. *Imperfect crystallizations:* stalactitic and mammillary forms, having an impalpably granular structure; coarse columnar, surface crystalline; delicately fibrous, rare; massive, impalpable, or coarse granular. *Pseudomorphs:* imitative of rhombohedrons, scalene dodecahedrons, and hexagonal prisms of calcareous spar—of the lenticular crystals of gypsum—of cubes and octahedrons of fluor spar.

H.=7. G.=2·6413—2·6541, Beudant; 2·6701, Haüy. *Lustre* vitreous, sometimes inclining to resinous; splendent—nearly dull. *Streak* white, of pure varieties; if impure, often the same as the color, but paler. *Color* white, when pure; often various shades of yellow, red, brown, green, and blue. Transparent—opaque. *Fracture* perfect conchoidal—subconchoidal. Tough—brittle—friable.

Quartz is pure silica. Impure varieties contain variable quantities of iron, alumina, manganese, or nickel, &c. Alone, before the blowpipe, it undergoes no change, but fuses readily with carbonate of soda, accompanied with a brisk effervescence, to a transparent glass.

The varieties arise either from crystallization or impurities, and are naturally distributed into three series, one (I) presenting the bright glassy lustre of broken *quartz crystal*, another (II) presenting the glistening subvitreous or waxy lustre, and translucency or subtransparency of *Chalcedony*, and the third (III) with the nearly dull lustre, dull colors, and opacity of *Jasper*.

I. *The vitreous varieties.*

Rock crystal includes pure crystals of quartz. This is the mineral to which the term *crystal* was first applied by the ancients, from the Greek word for ice, which it very much resembles in lustre and transparency, (§ 4.)

Amethyst is a clear, purple or bluish-violet variety of quartz crystal. The color is due to a small per centage of oxyd of manganese.

Rose quartz has a rose red or pink color and is transparent or nearly so. The cracks intersecting it in every direction often render it barely translucent in large fragments. The

specimens are usually massive, and often occur of large size, with the usual vitreous fracture of quartz. The lustre is sometimes a little greasy.

False topaz or Cairngorm stone is a light yellow pellucid variety of quartz crystal. It resembles yellow topaz, but is distinguished by its crystalline form, and the absence of cleavage in one direction.

Smoky Quartz has a brownish smoky tint. The crystals are often pellucid ; but occasionally the color is so deep as to render them nearly opaque except in thin fragments.

Milky Quartz, as the name implies, has a milk-white color. It is a massive vitreous variety, and one of the most common. It has sometimes a *greasy* lustre and is then called *greasy* quartz.

Prase is a leek-green variety of massive quartz.

Aventurine Quartz is minutely spangled throughout the mass with scales of yellow mica. It is usually translucent and of a gray, brown, or reddish-brown color.

Ferruginous Quartz is of an opaque red, brownish-red, or ochre yellow color. It occurs in distinct crystals; the crystals are sometimes minute and aggregated like the grains of sand in a sandstone, constituting masses with a brightly glistening lustre. The color is owing to oxyd of iron.

II. *Chalcedonic varieties.*

Chalcedony has usually the subdued lustre of wax, and is either translucent or subtransparent—some milk-white varieties are opaque. It occurs in mammillary and botryoidal shapes ; also as stalactites, in cavities lined or roofed with chalcedony.

Chrysoprase is an apple-green or leek-green variety of chalcedony; it is colored by nickel.

Carnelian is a beautiful reddish variety of chalcedony, generally of a clear bright t[illegible] It passes into common chalcedony through grayish-red varieties. Turpin has lat[illegible] stated that the color is owing to a minute species of vegetation, (Protococcus Kermesinus,) which was disseminated through the chalcedony, while it was in a gelatinous state.

Sard is a deep brownish-red chalcedony, of a blood-red color by transmitted light.

Agate is a variegated chalcedony. The colors are distributed in clouds, spots or bands. When in bands, the agate consists of parallel or concentric layers of chalcedony, of different colors, arranged often with the utmost delicacy and beauty. These concentric lines may occur in straight, circular, or zigzag forms. The latter are called *fortification* agates, from a striking resemblance to the angular outlines of a fortification.

In other agates the colors are owing to foreign matter disseminated through the mass.

Moss agate or Mocha stone is a chalcedony containing within dendritic or moss-like delineations of an opaque brownish-yellow color, which are due to oxyd of iron.

Onyx resembles agate, but the colors are arranged in flat horizontal planes. They are usually a light clear brown, and an opaque white. When the layers consist of sard and white chalcedony the stone is called a *sardonyx.*

Cat's eye is a translucent chalcedony presenting a peculiar opalescence, or glaring internal reflections, when cut *en cabochon*, which effect is owing to filaments of asbestus. The color is commonly light greenish-gray—sometimes yellow, red or brownish.

Flint is somewhat allied to chalcedony, but is more opaque, and presents dull colors, usually gray, smoky-brown, and brownish-black. The lustre is barely glistening, subvitreous. It breaks with a deeply conchoidal fracture and a sharp cutting edge.

Hornstone resembles flint, but is more brittle, and the fracture is more splintery. *Chert* is a term often applied to hornstone and to any impure flinty rock, including the jaspers.

III. *Jaspery varieties.*

Jasper is a dull red, yellow, brown, or green siliceous rock, compact, nearly or quite opaque, and presenting little beauty until polished. Besides the colors mentioned there are also blue and black varieties. When the colors are arranged in stripes or bands it constitutes the *Striped Jasper.*

Plasma is a green jasper with yellow and whitish dots, and a glistening lustre.

Blood stone or *Heliotrope* has a deep green color, and contains interspersed, blood-red spots, like drops of blood.

Lydian stone, Touchstone, or *Basanite* is a velvet black siliceous stone or flinty jasper, used, on account of its hardness and black color, for trying the purity of the precious metals. The color left on the stone after rubbing the metal across it, indicates to the ex-[illegible], the amount of alloy.

[illegible] above there is a light spongy variety of quartz, called *float stone*—the *quartz nectique* of Haüy—which is so light as to float on water. It consists of fibres or filamen-

tary crystals, aggregated into a spongy or porous mass. *Siliceous sinter* is a light cellular quartz. This term is also applied to a similar variety of opal. *Tabular quartz* consists of thin plates, either arranged parallel, or crossing one another and leaving open cells.

Quartz, in some of its varieties, occurs in almost every rock-stratum. It is an essential constituent of granite, gneiss, and mica slate, and of other rocks in primitive regions. The chalcedonic varieties occur principally in the vesicular cavities of trap, or basaltic rocks. Flint occurs imbedded in chalk. Jasper is associated with limestone like hornstone, and also with basaltic rocks and porphyry.

Switzerland, Dauphiny, Piedmont, the Carrara quarries, and numerous other foreign localities, afford fine specimens of rock crystal. The most beautiful amethysts are brought from India, Ceylon, and Persia, where they occur in geodes, and as pebbles; inferior specimens occur in Transylvania, in large crystalline groups; in the vicinity of Cork, and on the island of May in Ireland. The *false topaz* is met with in Brazil. *Rose quartz* occurs in a vein of manganese, traversing the granite of Rabenstein, near Zwiesel, in Bavaria. *Prase* is found in the iron mines of Breitenbrunn, near Schwartzenberg, in Saxony. The amygdaloids of Iceland, and the Faroe Islands, afford magnificent specimens of *Chalcedony;* also Huttenberg and Loben in Carinthia, &c. A small blue variety, in hexahedral crystals, (pseudomorphs of fluor,) occurs at Treszytan, in Transylvania. The finest *carnelians* and *agates* are found in Arabia, India, Surinam, and Saxony. Perthshire, and other parts of Scotland, afford smaller, but handsome specimens. *Chrysoprase* occurs at Kosemutz in Silesia. *Aventurine quartz,* at Cape de Gata in Spain. *Cat's eye* in Ceylon, the coast of Malabar, and also in the Hartz. *Plasma,* in India and China, whence it is usually brought in the form of beads. *Heliotrope,* in Bucharia, Tartary, Siberia, and the island of Rum in the Hebrides. *Float stone,* in the chalk formation of Menil Montant, near Paris, and in some of the Cornish mines. The banks of the Nile afford the Egyptian jasper; the striped jasper is met with in Siberia, Saxony, and Devonshire. A fine *yellow jasper* is found at Vourla, bay of Smyrna, in a low ridge of limestone, to the right of the watering place, between the harbor and the high hills that commence their rise about a mile back. It is here associated with a beautiful opal, coarse carnelians, chrysoprase, and hornstone, and these minerals seem to occupy in the limestone the place of hornstone, which is found in various parts of the adjoining country, and also at Napoli di Romania, in Greece. The Plains of Argos are strewed with pebbles of *red jasper.* A variety of sandstone occurs in thin layers at Villa Rica, Brazil, remarkable for its flexibility, owing apparently to the dissemination of small scales of mica through the mass.

Quartz crystals are obtained in great numbers and unusual beauty in Herkimer Co., N. Y., at Middlefield, Fairfield, Little Falls, Salisbury, and Newport. They lie loose in cavities in the calciferous sand-rock, or imbedded in loose earth, and sometimes, according to Beck, in powdered anthracite. The crystals often contain anthracite, and sometimes small cavities are filled with a fluid. In many places the soil abounds in them. Handsome druses of quartz are obtained at the same localities. Fine dodecahedral crystals (double six-sided pyramid) are obtained at the beds of specular iron in Fowler, Hermon, and Edwards, St. Lawrence County, New York; they are also found in the soil, and are then, in general, opaque and cellular. In Gouverneur, crystals of quartz occur with tourmaline, &c., in limestone, which have rounded angles, as if they had been partially fused. On the banks of Laidlaw lake, Rossie, there is a fine locality of quartz, in large implanted crystals. The Sterling ore bed, Antwerp, Jefferson Co., affords interesting dodecahedral crystals. Four miles east of Warwick, crystals presenting the primary form occur in jasper. At Palatine, Montgomery Co., quartz crystals occur, having one end terminated with the usual pyramid, while the other is rounded and smooth. Diamond rock, near Lansingburgh, is an old and well known locality, but does not now afford good specimens. At Diamond Island and Diamond Point, Lake George, quartz crystals occur, as in Herkimer County. Crystals with unusual modifications occur sparingly at the Charlestown syenite quarry, Mass. Pelham and Chesterfield, Mass., Paris and Perry, Me., and Meadow Mt., Maryland, are other localities of quartz crystals. At Chesterfield, small unpolished *rhombohedrons* have been found in granite; and Paris, Me., affords handsome crystals of brown or smoky quartz. Drusy quartz, of brown, apple-green, and other tints, is abundant at New Fane, Vt.

Rose quartz occurs at Albany and Paris, Me., Acworth, N. H., Williamsburg, Mass., Southbury, Conn., and Port Henry, Essex Co., N. Y.; smoky quartz at Goshen, Mass., Richmond County, N. Y., &c.: amethyst in trap at Keweena Point, Pic Bay, and Gargontwa, on Lake Superior: also in the same rock at Bristol, Rhode Island, and sparingly throughout the trap region of Massachusetts and Connecticut. Chalcedony and agates of moderate beauty are found in the same trap region; more abundantly about Lake Su-

perior, the Mississippi, and the streams to the west, and about the Willammet, Columbia, and other rivers in Oregon.

Belmont's lead mine, St. Lawrence Co., N. Y., has afforded fine specimens of chalcedony and chrysoprase, associated with calc spar. Red jasper is found at Saugus, near Boston, Mass., on Sugar Loaf Mt., Maine, in pebbles on the banks of the Hudson at Troy. Yellow jasper occurs with chalcedony at Chester, Mass. Heliotrope occupies veins in slate at Bloomingrove, Orange Co., N. Y.

Pseudomorphs, imitative of hexagonal and scalenohedral crystals of calcareous spar and cubic crystals of fluor, occur at West Hampton, Mass. Petrified wood consists often of quartz, and sometimes of chalcedony or agate, of rare beauty.

Quartz crystals occasionally occur of enormous size. A group in the museum of the university at Naples, weighs nearly half a ton. A crystal, belonging to Sig. Rafelli of Milan, measures three and a quarter feet in length, and five and a half in circumference, and its weight is estimated at eight hundred and seventy pounds: another at Paris is three feet in diameter, and weighs eight hundred weight. About a century since, a drusy cavity was opened at Zinken, which afforded 1000 cwt. of rock crystals, and at that early period brought $300,000. One crystal weighed 800 pounds. Crystals often exhibit very beautiful internal iridescences, owing to fissures or fractures. This effect may be produced artificially, by heating the crystal nearly to redness, and plunging it, while hot, into cold water. Foreign substances frequently penetrate or thoroughly permeate crystals of quartz. Iron has already been alluded to as one of these permeating substances. Chlorite is sometimes so thoroughly intermingled, that the crystals appear to be composed entirely of this material; their hardness, however, shows their siliceous nature. Anthracite, asbestus, actinolite, rutile, tourmaline, silver, and copper, are other penetrating substances. Specimens containing acicular crystals of rutile, are often very beautiful. The most interesting of the substances occurring in quartz, are the fluids, which occupy small cavities in the interior of crystals. The fluid cannot be detected, on account of its colorless transparency, unless there is a small bubble of air present, which moves on turning the crystal, like the bubble in a spirit level. These cavities are sometimes of considerable size. Jacobson, of Copenhagen, possesses a geode of quartz, an inch and a quarter long, which contains at least half a cubic inch of fluid. This liquid is usually water; but occasionally it is a bituminous fluid resembling naphtha. Mr. Allan describes a crystal of amethyst in his collection, having four cavities partly filled with this peculiar fluid; at 83° F., the fluid dilates and fills all the cavities, and on cooling, reappears with ebullition.

Silica is held in solution in the hot waters of the Geysers of Iceland, whose solvent powers are supposed to be due to their temperature, and a small quantity of alkali present. The Geysers have covered the part of Iceland in their vicinity with a siliceous sinter. For an account of some instances of gelatinous silica in rocks, see § 86.

Several varieties of this species have long been employed in jewelry. The *amethyst* has always been esteemed for its beauty. Like most other stones, it is less brilliant by candle light; it appears to best advantage when surrounded with pearls and set in gold. The color of the amethyst is often irregularly diffused, as is well described by Pliny, "ad viciniam crystalli descendet albicante purpuræ defectu,"—purple, gradually fading into white. It was called *amethyst*, *ἀμέθυστος*, on account of its pretended preservative powers against intoxication, from *α*, *not*, and *μεθυω*, *to intoxicate*. This is not, however, the only *amethyst* of the ancients. The violet colored sapphire, the violet fluor spar, (sculpturis faciles, *Plin.*, *easily graven*,) and some other purple species, were designated by the same name; and it has been supposed that garnet was also included, (Moore's An. Min.)

Cameos are in general made of onyx, which is well fitted for this kind of miniature sculpture. The figure is carved out of one layer, and stands in relief on another of different color. The most noted of the ancient cameos, is the Mantuan vase at Brunswick. It was cut from a single stone, and has the form of a cream pot, about seven inches high and two and a half broad; on its outside, which is of a brown color, there are white and yellow groups of raised figures, representing Ceres and Triptolemus in search of Proserpine. The Museo Borbonico, at Naples, contains an onyx measuring eleven inches by nine, representing the apotheosis of Augustus, and another exhibiting the apotheosis of Ptolemy on one side, and the head of Medusa on the other; both are splendid specimens of the art, and the former is supposed to be the largest in existence.

The carnelian (sarda of Pliny) receives a fine polish, and is often rich in color; but is too common to be much esteemed. When first obtained from the rock, carnelians are usually gray or grayish-red; they receive their fine colors from an exposure of several weeks to the sun's rays, and a subsequent heating in earthen pots. The colors of agate, when indistinct, may be brought out by boiling in oil, and afterwards in sulphuric acid; the

latter carbonizes the oil absorbed by the apparently porous layers, and thus increases the contrast of the different colors. Agate is often made into mortars for chemical and pharmaceutical preparations, and according to Pliny, it was employed for the same purpose by the physicians of his day. In Germany it is made into cups and plates. The royal collection at Dresden contains a table service of German agate; and at Vienna, in the imperial cabinet, there is an oval dish twenty-two inches in length, formed from a single stone. The agate, or *achates* of the Greeks, was so called from the river Achates, in Sicily, whence, according to Theophrastus, these stones were originally brought. *Iaspachates* corresponded to our jasper agate; *Sardachates* contained layers of the sard, or carnelian; *Dendrachates* (from δενδρον, *a tree*, and *achates*) was our moss agate; *Hæmachates* (from αιμα, *blood*, and *achates*) was an agate, sprinkled with spots of red jasper, (Moore's An. Min.) Turpin has lately shown that the red color of agates and carnelians is owing to a minute species of vegetation called Protococcus Kermesinus, enclosed when in a gelatinous state.

Jasper admits of a brilliant polish, and is often formed into vases, boxes, knife-handles, &c. It is also extensively used in the manufacture of Florentine mosaics. The iaspis of the ancients, whence our word jasper is derived, appears to have included the green or blue colored variety, together with some other stones, not of the jasper kind. Quartz is a necessary ingredient in the manufacture of glass and porcelain, and is also employed in the smelting of ores, particularly copper, and in other metallurgical operations. With lime it forms mortar. The uses of flint are well known.

Porcelain jasper is sometimes referred to this species. It is, however, merely a clay, indurated by heat. It fuses readily, and is thus distinct from quartz. It occurs near Carlsbad, in Bohemia.

OPAL. Hyalus opalinus.

Uncleavable Quartz, *M.* Hyalite. Muller's Glass. Hydrophane. Menilite. Cacholong. Silicious Sinter. Pearl Sinter, Florite. Gyrasol. Eisenopal, *Haus.* Quartz Hyalin Concretionée, Quartz Résinite, *H.* Opalus, Pæderos, *Pliny.* οπάλλιος. Michaelite. Alumocalcite.

Impalpable structure; small reniform and stalactitic shapes, and large tuberose concretions. Pseudomorphs imitative of calcareous spar.

H.=5·5—6·5. G.=2·0—2·21. *Lustre* vitreous, frequently subvitreous, and often inclining to resinous, and sometimes to pearly. *Streak* white. *Color* white, yellow, red, brown, green, gray, generally pale; dark colors arise from foreign admixtures. Some specimens exhibit a rich play of colors; others present different colors by refracted and reflected light. The play of colors is destroyed by heat.

Composition, according to Bucholz and Klaproth, (Beit. ii, 151 and 165,)

	Hyalite.	*Precious Opal.*	*Menilite.*
Silica,	92·00	90·0	85·5
Water,	6·33=98·33, B.	10·0=100, K.	11·0=96·5, K.

Menilite often contains, also, small portions of iron, alumina, lime, and carbon. Before the blowpipe opal is infusible, but decrepitates, gives out water, and becomes opaque. Some varieties become red in consequence of the iron they contain. Damour has lately found that opal, on distillation, affords ammonia as well as water, showing that it contains organic matter; and the same is true of semi-opal, pitchstone, firestone, &c., (Ann. des Mines, xvii, 202.)

The *precious opal* exhibits a beautiful play of colors. *Fire opal* or *girasol* presents bright hyacinth-red and yellow reflections. *Common opal* and *semi-opal* are common varieties, not exhibiting the opalescence of the precious or fire opal; they are distinguished from one another by their degrees of transparency and lustre. *Hydrophane* is a variety of opal which is not transparent, but becomes so when immersed in water. *Cacholong* is nearly opaque, and of a porcelain or bluish-white color; it adheres to the tongue, and contains a small portion of alumina. It is closely allied to, and often associated with hydrophane. *Hyalite*, or *Muller's glass*, occurs in small reniform, botryoidal, and occa-

sionally stalactitic shapes, either colorless and pellucid, or white. *Menilite* is a brown, opaque variety, occurring in compact reniform masses, occasionally presenting a slaty structure. *Opal jasper* contains several per cent. of iron, and is the analogue in this species of the jasper in the preceding. *Silicious sinter* is a loose silicious aggregate, deposited by the Geysers of Iceland, where it presents porous stalactitic, fibrous, "cauliflower-like," and occasionally compact concretions. *Pearl sinter*, or *fiorite*, occurs in the cavities of volcanic tufa, in smooth and shining globular and botryoidal masses, which have a pearly lustre. *Wood opal* has a peculiar ligneous structure. *Michaelite* (from the island of St. Michaels, Azores) is a white fibrous pearly variety, consisting, according to Webster, of Siliça 83·65, water 16·35. Sp. gr.=1·88. *Alumocalcite* is an impure opal of a bluish milk-white color, containing 6 per cent. of lime.

OBS. Opal occurs in short irregular veins in porphyry; also in the vesicular cavities of amygdaloid. Common opal sometimes occurs in limestone, with hornstone. Menilite is met with in clay slate. Some varieties are found with galena and blende, in metalliferous veins. It also occupies the interior of fossils in sandstone.

The precious opal occurs in porphyry at Czervenitza, near Cashau in Hungary, and at Gracias a Dios in Honduras, S. A. Fire opal is brought from Zimapan in Mexico, and from the Faroe Islands. The common opal exists abundantly in Hungary, in Faroe, Iceland, the Giants' Causeway, and the Hebrides. An interesting variety occurs within a half mile, and to the southwest of the watering place at Vourla, the harbor of Smyrna, along with yellow jasper and hornstone, imbedded in a low ridge of compact limestone, of a light yellow or grayish-white color. Its colors are wax-yellow and grayish-green, occasionally white. Hungary affords also the hydrophane. The Giants' Causeway affords small masses resembling mountain cork, which, though opaque, become translucent on immersion in water. Cacholong occurs in loose masses on the river Cach, in Bucharia, whence its name. Hyalite occurs in amygdaloid at Schemnitz, in Hungary, and in clinkstone at Waltsch, in Bohemia. Menilite is found imbedded in adhesive slate, at Menil Montant, near Paris. Wood opal forms large trees in the pumice conglomerates of Saiba near Neusohl, and Kremnitz in Hungary, in Faroe, and other trap countries. In Van Dieman's Land, forty miles above Hobart town, on the river Derwent, it is said to occur in large trunks. A magnificent specimen in the Liverpool Museum from this locality, weighs between two and three hundred pounds.

Hyalite is the only variety of this species which has been met with in the United States. It occurs sparingly at the Phillips ore bed, Putnam Co., N. Y., in thin coatings on granite; also in Burke and Scriven Cos., Georgia. In the latter region it lines cavities in a silicious shell-rock. The Suanna spring in Florida, affords small quantities of silicious sinter.

The precious opal, when large, and exhibiting its peculiar play of colors in perfection, is a gem of high value. It is cut with a convex surface. The largest mass of which we have any knowledge, is in the imperial cabinet of Vienna; it has almost the size of a man's fist, and weighs 17 ounces, but contains numerous fissures, and is not entirely disengaged from the matrix. This stone was used as a gem by the Greeks and Romans, and was called opalus; also *pæderos*, *παιδέρως*, in allusion to its color and lustre, as expressed in the Orphic poem, *ἱμεροῦ τέρενα χρόα παιδὸς*, "having the delicate complexion of a lovely youth," (Moore's An. Min.)

OBSIDIAN.

Empyrodox Quartz, *M.* Indivisible Quartz, Fusible Quartz, *J.* Pearlstone—Pitchstone. Pumice Marekanite. Pechstein, Perlstein, Bimstein *of the Germans*. Petrosilex resinite. Feldspath resinite, *H.*

No regular forms or cleavage.

H.=6—7. G.=2·396, obsidian from Iceland; 2·212, pitchstone from Meissen. *Lustre* vitreous—pearly. *Streak* white—grayish white. *Color* black, brown, red, green, gray, white; none bright. Subtransparent—subtranslucent. *Fracture* conchoidal.

Obsidian was formerly distributed into the four so called species, *obsidian*, *pitchstone*, *pearlstone*, and *pumice*. *Obsidian* more nearly resembles glass in its appearance, and is often called volcanic glass. *Pitchstone* has a resinous lustre and a splintery fracture. Its colors are principally brown, green, or red. It presents frequent transitions into obsidian on one side and pearlstone on the other. *Pearlstone* is a gray variety with a pearly lustre; it occurs in rounded balls, one to two inches in diameter, usually composed of thin concentric laminæ, and often containing, as a nucleus, a grain of obsidian; the *spherulite* variety occurs in small globules, with a structure somewhat fibrous. *Pumice* is a vesi-

cular obsidian. It occasionally presents a silky fibrous structure; at other times it has a more glassy texture. Its vesicular structure renders it buoyant for a time on water. *Marekanite* is a pearl-gray translucent variety, from Marekan in Kamschatka.

Composition, according to Berthier, Thomson, and Descotils,

	Obsidian.	*Pitchstone,* Arran.	*do.,* Saxony.	*Pearlstone.*	*Obsidian*
Silica,	69·46	63·500	73·100	70·400	72·0
Protox. iron,	2·60	3·796	0·864	Perox. 4·384	2·0
Alumina,	2·60	12·736	13·560	11·600	12·5
Soda,	5·08	6·220	6·320	——	} 10·0
Potash,	7·12	——	——	5·200	
Lime,	7·54	4·460	1·484	3·000	——
Water,	3·00	——	4·724	4·280	——
Magnesia,	2·60	volatile, 8·000	——	——	——
	100·00, B.	98·712, T.	100·052, T.	98·864, T.	96·5, D.

These varieties fuse with more or less facility before the blowpipe, to a vesicular glass of a white or gray color.

Obs. The several varieties of this species generally occur in rocks of igneous origin. They occasionally form the paste of porphyries. They have also been observed forming beds or irregular veins in sandstone. Pumice is a product of modern volcanoes.

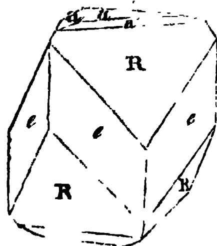
Obsidian occurs in Iceland, the Lipari Islands, Island of Milo and other islands in the Archipelago; also at Ascension, Teneriffe, in Siberia, and Mexico. The hills around the valley of Tribisch, near Meissen in Saxony, afford abundantly the *pitchstone* variety; at Arran in the Isle of Man, it forms extensive beds in granite, and contains, according to Knox, 2 per cent. of bitumen. This bitumen is driven off by heat, and the pitchstone transformed into a vesicular glass. It occurs also at Newry, County Down, Ireland, in smooth lamellar concretions, of a mountain or leek-green color. Pearlstone forms extensive beds in Hungary, between Tokay and Keresztur, at Glashutte, near Schemnitz, and elsewhere; also in Iceland, Spain, and Mexico. Pumice forms a hill eight hundred or one thousand feet in height, on the island of Lipari, termed from its scanty vegetation and peculiar whiteness Campo Bianco. From this locality and the isles of Ponza, pumice is exported in large quantities for commerce. It occurs also in Hungary, at Teneriffe, &c., but in smaller quantities and of inferior quality. These different varieties often contain imbedded crystals of glassy feldspar, particularly those from Ischia: some obsidians occasionally include particles of olivine and traces of other volcanic minerals.

Some varieties of obsidian admit of a high polish, and have been employed for mirrors; the inhabitants of Mexico formerly made it into knives, arrowheads and other war instruments. Certain specimens present an olive-green opalescence, and are therefore valued by the lapidary. Pumice is very extensively employed for grinding and polishing, both in the solid and pulverized state. It is often a convenient filtering material.

Obsidian results from the fusion of several minerals, and is properly a volcanic slag. As might be expected, the analyses disagree widely. It is not entitled to a place among mineralogical species.

EUDIALYTE. ALMANDIUS RHOMBOHEDRUS.

Rhombohedral Almandine-Spar, *Haid.* Eudyalite, *improper orthography.*



Primary form, an acute rhombohedron; R : R=73° 40′, and 106° 20′; 73° 30′, and 106° 30′, according to Miller. *Secondary form:* R : e=143° 10′, R : a=112° 33′, R : a′=113° 44′. a : e=90°. Miller obtained for another crystal having three additional planes, e, *a′*, and *a*, a : a′=148° 38′, a : R=112° 18′, a : e=129° 22′, a : *a′*=101° 35′, a : *a*=90°, *a′* : *a′*=126° 25′. *Cleavage* parallel with a, very perfect. Occurs massive.

H.=6. G.=2·9036. *Lustre* vitreous. *Streak*

white. *Color* brownish-red, rose-red. Opaque—slightly translucent. *Fracture* subconchoidal or splintery.

Composition, according to Stromeyer, (Untersuchungen, p. 438,)

Silica,	52·47	53·325
Zirconia,	10·89	11·102
Lime,	10·14	9·785
Soda,	13·92	13·822
Peroxyd of iron,	6·85	6·754
Peroxyd of manganese,	2·57	2·062
Muriatic acid,	1·03	1·034
Water,	1·80=99·67	1·801=99·685

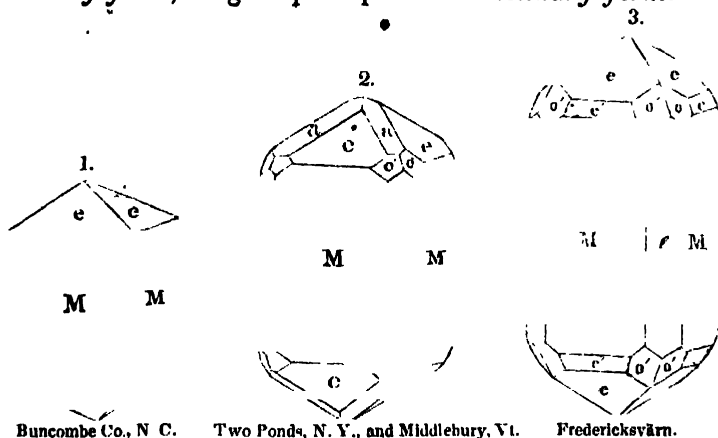
Fuses before the blowpipe to a leek-green scoria or opaque glass. When pulverized, it gelatinizes with acids.

Obs. The only known locality is at Kangerdluarsuk, in West Greenland, where it is either associated with hornblende and sodalite, or imbedded in compact white feldspar. The crystals are usually small, but sometimes occur an inch or more in length. It was first described by Stromeyer, who gave it the above name on account of its easy solubility in acids, from εὖ, *easily,* and διαλυω, *to dissolve.*

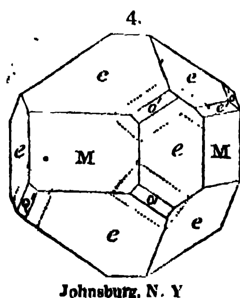
ZIRCON. Zircon quadratus.

Prismatic Zircon, *M.* and *J.* Hyacinth. Jargon. Zirconite. Silicate of Zirconia. Zirkon.

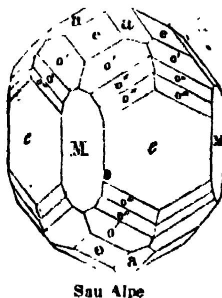
Primary form, a right square prism. *Secondary forms:*



Buncombe Co., N. C. Two Ponds, N. Y., and Middlebury, Vt. Fredericksvärn.



Johnsburg, N. Y.



Sau Alpe

M : e=135°, M : e=132° 10′, e : e=123° 19′, M : e′=159° 47′, o′ : o′=132° 43′, 147° 3′, a : e=122° 39′, a : e=151° 39′. *Cleavage* parallel to M; also less distinct parallel to e. It occurs also in irregular forms and grains.

H.=7·5. G.=4·5—4·75; 4·505, Haidinger; 4·681, Thomson; 4·721, Lowry; 4·453, a crystal from Buncombe Co., N. C, Vanuxem. *Lustre* more or less perfectly adamantine. *Streak* white. *Color* red, brown, yellow, gray, white. Transparent—subtranslucent. *Fracture* conchoidal, and brilliant.

Composition, according to Vauquelin, (J. des Mines, N. 26, p. 106,) Muir, (Thom. Min. i, 426,) Berzelius, (K. V. Ac. H. 1824, p. 106,) and Vanuxem, (J. Ac. Sci. Phil., iii, 59,)

	Expailly.			North Carolina.
Silica,	31	33·32	33·48	32·08
Zirconia,	66	66·00	67·16	67·07
Oxyd of iron,	2	trace	——	——
	99, Van.	99·32, Muir.	100·64, Berz.	99·15, Van.

It loses its color, but is infusible alone, and also with carbonate of soda and salt of phosphorus. With borax it melts to a diaphanous glass.

Hyacinth includes those individuals which present bright colors, considerable transparency, and smooth and shining surfaces. *Zirconite* presents grayish or brownish tints, and is frequently rough or opaque. The variety from Ceylon, which is colorless, or has a smoky tinge, and is therefore sold for inferior diamonds, is sometimes called *jargon*.

Hyacinth occurs in the sand and alluvial deposits of certain rivers in Ceylon, at Expailly, near Le Puy, France, at Ohlapian in Transylvania, occasionally in volcanic tufa in Auvergne, and at Vesuvius. Siberia affords crystals as large as walnuts. Splendid specimens occur also in Greenland, and in the zircon-syenite of Fredericksvärn in Norway.

In Buncombe Co., N. C., on the road leading from the Saluda Gap to Ashville, upon the first elevation, after passing Green river, very beautiful crystals of zircon are found loose in the soil, and sometimes attached to feldspar and quartz. In New York, zircon occurs in variously modified crystals of a cinnamon-red color at Hall's mine in Moriah, Essex Co., in a vein of quartz running through the ore: near the outlet of Two Ponds, Orange Co., it is associated with scapolite, pyroxene, and sphene, in crystals sometimes an inch in length; on Deer Hill, a mile southeast of Canterbury, in the same county, crystals are abundant. They have a deep brownish-red or black color, and occasionally are an inch and a half in length: chocolate-brown crystals are obtained in Warwick, at the southern base of Mount Eve, in limestone and scapolite: near Amity, and also in Monroe and Cornwall, are several localities of zircons, presenting white, reddish-brown, clove-brown, and black colors. In St. Lawrence Co., fine zircons occur with apatite at Robinson's, in the town of Hammond, near De Long's Mills: some of the crystals are an inch and a half long, and half an inch wide, and they sometimes contain, according to Beck, a nucleus of carbonate of lime. Johnsburgh, in Warren Co., also affords interesting crystals of zircons. In New Jersey, zircons have been obtained at Franklin, and in gneiss at Trenton. Loose masses of syenite at Middlebury, Vt., have afforded some specimens; also talcose slate at Easton, Penn. The chrysoberyl at Haddam, and the Sillimanite at Norwich, are associated with small zircons.

Hyacinth occurs of sufficient dimensions to be valuable as a gem.

It is very doubtful whether the modern hyacinth is one of the number of stones that were called hyacinth (ὑάκινθος) by the ancients. Jameson seems to have supposed that they applied this name to the amethyst or sapphire.

OSTRANITE. ZIRCON RHOMBICUS.

Breithaupt, New Phil. Jour. iv, 186, 1827–8.

Primary form, a right rhombic prism; M : M=96° and 84°. *Secondary form*: the prism with the lateral edges slightly trun-

cated, and the basal edges deeply replaced. e : e=128° 14′, and 133° 42′. *Cleavage* parallel with $\check{c}$, (shorter diagonal,) scarcely perceptible.

H.=6—6·5. G.=4·32—4·4. *Lustre* vitreous. *Color* clove-brown, sometimes with smoky-gray spots. *Streak* lighter than the color, grayish or white. Very brittle.

It does not fuse before the blowpipe, but the color becomes paler. With borax it melts with difficulty to a transparent glass. It is insoluble in nitric acid.

OBS. This mineral occurs in Norway, and it is supposed in the zircon-sienite of Fredericksvärn. The specimens examined were part of the collection of Chev. Heyer of Dresden: they are about an inch in length. It resembles zircon, but differs in crystallization.

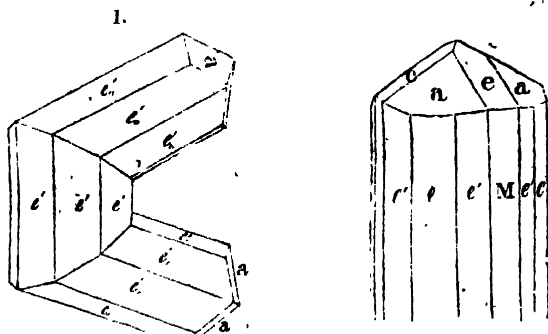
This species was named by Breithaupt after the goddess Ostra.

ORDER VII. SCAPTINEA.

RUTILE. RUTILUS QUADRATUS.

Peritomous Titanium-Ore, *M.* Crispite. Gallizinite. Sagenite, *Saussure.* Titane Oxydé, *H.* Titanic Acid, *Thom.*

Primary form, a right square prism. *Secondary forms:* fig. 51, Pl. I, with the planes a so extended as to form a four-sided pyramid at each extremity of the crystal. Also the annexed figures:



M : e=135°, M e'=161° 34', e : e'=150° 26', a : a=117° 2', a : e=148° 31', M : e=123° 59', e : e=128° 41'. *Cleavage:* lateral, distinct; diagonal, less so. M, *e* and *e'*, are usually vertically striated. Crystals often acicular. *Compound crystals:* they occur under the form of singly and doubly geniculated crystals; one of the latter kind is represented in fig. 1. For an explanation of these forms, see § 77. *Imperfect crystallizations:* structure granular, particles of various sizes, and strongly coherent.

H.=6—6·5. G.=4·18, Klaproth; 4·249, Mohs; a dark variety from Ohlapian. *Lustre* metallic-adamantine. *Streak* very pale brown. *Color* reddish-brown, passing into red; sometimes yellowish. Subtransparent—opaque. *Fracture* subconchoidal, uneven. Brittle.

When pure, it is composed of titanium 60·29, and oxygen 39·71; but nigrine contains about 14 per cent. of oxyd of iron. Before the blowpipe alone it remains unaltered. With borax it forms a hyacinth-red bead. It communicates a pale-red color to salt of phosphorus, but does not fuse with it.

OBS. Rutile occurs in granite, gneiss, mica slate, and syenitic rocks, and sometimes in granular limestone. It is generally found in imbedded crystals, in masses of quartz or feldspar, and often occurs in acicular crystals. It has also been met with in specular iron.

It occurs in specular iron in the Grisons. Brazil affords acicular crystallizations in limpid quartz. At Yricix in France, and in Castile, geniculated crystals are obtained, often of large size. At Ohlapian in Transylvania, it is found in pebbles, of a black color, and hence is called nigrine. A massive variety occurs in Arendal in Norway; also at Karingbricka in Sweden; the latter is said to contain 3 per cent. of chrome, and is the *Titane oxidé chromifère* of Haüy.

Fine rutiles occur in gneiss at Barre, Mass.; the crystals are occasionally an inch and a half in diameter. At Windsor, Mass., it occurs thickly disseminated through veins of feldspar intersecting chlorite slate. At Shelburn it is found in modified and compound crystals in mica slate, at Leyden with scapolite, and at Conway with zoisite. It is occasionally obtained in beautiful translucent crystals in the Middletown feldspar quarry, Conn., associated with apatite and albite. It occurs sparingly at Lyme, N. H., with tourmaline, and at Newton, N. J., along with spinel. At Warren, Me., it is found along with tremolite and copper pyrites. Compound crystals of a dark color are occasionally found at Lane's Mine, Monroe, Conn., and also in the adjoining town of Huntington. The vicinity of Hanover, N. H., has afforded splendid specimens of quartz penetrated with acicular crystals of rutile. In Orange Co., N. Y., there are several localities: a mile north of Edenville it occurs with pargasite in limestone boulders; two miles east of Warwick in granite with zircon; a mile east of Amity in quartz with brown tourmaline, and two miles west with spinel and corundum, and also two miles southwest in dark blue eight-sided prisms, associated with red spinel, chondrodite, &c.; also near Warwick in slender prisms penetrating quartz. In New York County in veins of quartz, feldspar, and mica, traversing granular limestone at Kingsbridge; Gouverneur, N. Y., and the limestone of Essex Co. has also afforded some crystals. Fine crystals of rutile are obtained at Georgetown, D. C.

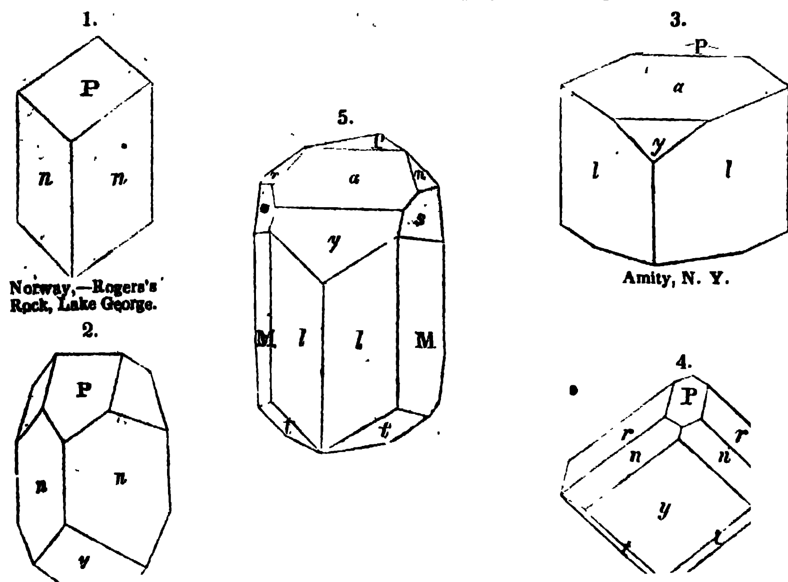
The finer specimens of this species, from Middletown, Conn., when cut and polished, form a gem of rare beauty. The oxyd of titanium is employed in painting porcelain, and quite largely for giving the requisite tint to artificial teeth.

Rutile is so named in allusion to its color, from the Latin *rutilus*, which signifies both *red* and *resplendent*. Saussure named a reticulated variety *sagenite*, from σαγήνη, *a net*.

SPHENE. Rutilus obliquus.

Hemi-prismatic Titanium Ore, *M.* Titanite. Braun-Menakerz, Gelb Menacherz, Menachine Ore, *Wern.* Sphene Titane Silico-calcaire, *H.* Lederite, *Shepard.*

Primary form: an oblique rhombic prism. M : M=76° 1′. *Secondary forms:* n : n=136° 8′, P : y (adjacent planes)=60° 24′.



$r : = r$ 113° 27′, $t : t$=110° 51′, $l : l$=133° 48′, $s : s$=67° 46′. *Cleavage:* sometimes distinct parallel with r; still less so parallel with l and P, and not easily obtained. *Imperfect crystallizations:* lamellar and granular structure; particles in the latter strongly coherent.

H.=5—5·5. G.=3·468, Haidinger. 3·2378, of a specimen from St. Gothard, Cordier. *Lustre* adamantine—resinous. *Streak* white. *Color* brown, gray, yellow, green, and sometimes black. Transparent—opaque. Brittle.

Composition, according to Klaproth (Beit. i, 251) and Cordier, (Jour. des Mines, xiii, 70,)

Silica,	35	28·0
Titanic acid,	33	33·3
Lime,	33=101, K.	32·2=93·5, C.

Before the blowpipe the yellow varieties are not altered in color; the others become yellow. They slightly intumesce, and fuse on the edges to a dark enamel. With borax they afford a yellowish-green glass. They dissolve in heated nitric acid, with the exception of a silicious residue.

Obs. This species was formerly divided into *titanite* and *sphene;* the former included the brown or black varieties, the latter the lighter colored and translucent.

Sphene occurs interspersed among primary rocks, in gneiss, granite, mica slate, and granular limestone; also in syenite, and beds of iron ore.

Titanite occurs with pyroxene, in beds of iron ore, at Arendal in Norway, in granite at Sartut in Greenland. Sphene in complicated compound crystals, of a pale green color and transparent, occurs at Graubinden in the Grisons, associated with feldspar and chlorite; in mica slate at St. Gothard; also at Mont Blanc, and elsewhere, in the Alps. Small crystals occur in syenite at Strontian in Argyleshire, and Critlle in Galloway. Occasionally it is found among volcanic rocks, as at the Laacher See, and Andernach on the Rhine.

In Canada, at Grenville, and in Bucks Co., Penn., three miles west of Attleboro', it is associated with tabular spar and plumbago. At Rogers's Rock, on Lake George, it occurs very abundantly in small brown crystals, along with graphite and pyroxene. At Gouverneur, N. Y., it occurs in black crystals in granular limestone with scapolite. Near Natural Bridge, Lewis Co., dark brown crystals occur with pyroxene and scapolite, among which is the variety called Lederite. In Orange Co., N. Y., large crystals occur abundantly in limestone, near Duck-cedar pond, in the town of Monroe; near Edenville, in light brown crystals, sometimes nearly two inches across, disseminated through limestone; 5 miles south of Warwick, in large grayish-brown crystals, with zircon, hornblende, and iron ore; also, in small crystals a mile south of Amity. In Westchester Co., near Peekskill, in an aggregate of feldspar, quartz, and hornblende; also near West Farms, in small reddish-brown prisms. In Massachusetts, very good sphene occurs in gneiss, in the east part of Lee; also at Bolton, with pyroxene and petalite in limestone. It is found also at Pelham, in the same State, at Trumbull, Conn., and at Thomaston in Maine. At Franklin, N. J., a honey-colored variety is obtained.

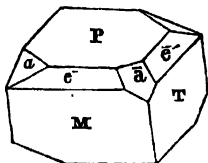
The name *sphene* was applied to this mineral in allusion to the form of the crystal, from σφην, *a wedge;* and the name *Titanite*, from its containing *Titanium* as a principal ingredient.

The *Lederite* of Shepard is identical in crystallographic, as well as other characters, with common sphene; it included crystals having the form represented in fig. 4. The figures given will illustrate satisfactorily the complex crystallizations of this mineral.

GREENOVITE. RUTILUS ROSEUS.

Dufrénoy, Ann. des Mines, xvii. *Breithaupt*, Pogg. lviii, 277, 1843.

Primary form, an oblique rhomboidal prism, Dufrénoy—P : M =87° 10′, P : T=85° 50′, M : T=110° 35′, P : ā=140° 7′, P : *a*=153° 25′, P : ē′=155° 37′, As Phillips suggests, from the symmetry of the crystal and the small difference obtained in the angles between M and T on P, it will probably prove to have a rhombic and not a rhomboidal primary.



H. above 5; according to Breithaupt, fresh specimens, =7. G.=3·44, Duf.; 3·527, Breit. *Lustre* splendent and vitreous on a cleavage face; between vitreous and greasy on a surface of fracture: face P, often dull and tarnished. *Color* rose-red and flesh-red. *Streak* reddish-white.

Composition, according to Cacarrié, (Ann. des M., xvii,) Titanic acid 74·5, oxyd of manganese 24·8, lime, a trace=99·3. Not acted on by acids. Alone before the blowpipe infusible. With soda, gives the reaction of manganese. It is considered a *manganesian sphene*.

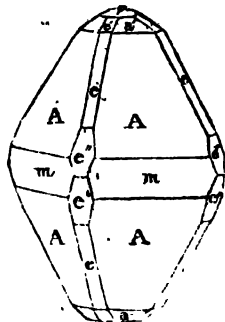
OBS. Greenovite was discovered in the manganese deposit of Saint Marcel in Piedmont. It occurs in rose-colored veins which run irregularly in the mass, and is associated with quartz, epidote, and manganesian garnets. It was named by Dufrénoy in honor of G. B. Greenough.

ANATASE. RUTILUS PYRAMIDALIS.

Pyramidal Titanium-Ore, *M.* Octahedrite, *J.* Oisanite. Titane Anatase, *H*

Primary form, a square octahedron; A : A (over a terminal edge)=97° 56′, A : A (over a basal edge)=136° 22′. *Secondary form*: A : e =138° 58′, A : m=158° 11′, A : p=111° 49′ á : m=116° 33′, e″ : e″=148° 23′. *Cleavage* parallel to A and *p*, perfect.

H.=5·5—6. G.=3·857, Haüy; 3·826, Mohs. *Lustre* metallic-adamantine. *Streak* white. *Color* various shades of brown, passing into indigo-blue; greenish-yellow by transmitted light. *Fracture* subconchoidal, scarcely observable.



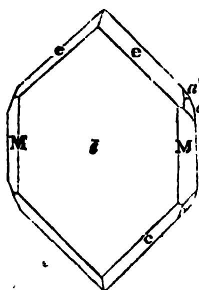
Anatase is pure oxyd of titanium, and before the blowpipe exhibits the phenomena of that substance. When heated it gives out a reddish-yellow phosphorescent light, which appears suddenly like a flame and is soon over; a peculiarity, according to Sir D. Brewster, not met with in any other species.

OBS. Anatase occurs most abundantly at Bourg d' Oisans in Dauphiny, accompanying feldspar, axinite, and Crichtonite. It is also found in mica slate in the Grisons, and at Tavatsch in the Tyrol. In Brazil it occurs both imbedded in quartz, and in detached crystals of so splendent a lustre, as to be sometimes mistaken for diamonds.

According to Beck, anatase accompanies native titanium in slags from the iron furnaces of Orange County, N. Y.

BROOKITE. Rutilus Brookianus.

Brookite, *Levy*, Ann. Phil. 2d ser. ix, 140. Prismatic Titanium-Ore, *Haid.* Jurinite, *Soret.*



Primary form, a right rhombic prism; M : M =100°. *Secondary form:* M : ē=140°, e : e=135° 46′ and 101° 37′. *Cleavage* parallel to M indistinct; parallel to P still more so.

H.=5·5—6. *Lustre* metallic-adamantine. *Streak* yellowish-white. *Color* hair-brown, passing into deep orange-yellow and some reddish tints. Translucent—opaque. Brittle.

It contains oxyd of titanium, with traces of oxyd of iron and manganese, but has not yet been analyzed.

Obs. Brookite was first observed among some minerals accompanying titanite from Dauphiny, by M. Soret, of Geneva. It has since been discovered in finer crystals at Snowdon, Wales. It was named by Mr. Levy, in honor of Mr. Brooke.

It occurs, according to Mr. Joseph A. Clay, of Philadelphia, at the Phenixville tunnel on the Reading railroad, Pennsylvania, associated with pearl spar.

PEROVSKITE. Rutilus cubicus.

G. Rose, Pogg. xlviii, 558.

Primary form, the cube. *Cleavage* tolerably perfect parallel with the faces of the cube.

H.=5·5. G.=4·017. *Lustre* metallic-adamantine; less bright on a cleavage face. *Streak* grayish-white. *Color* grayish to iron-black. Opaque.

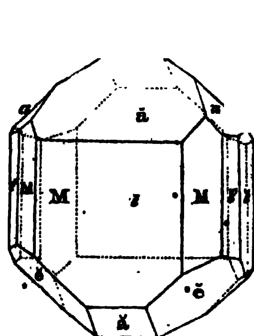
According to Rose, Perovskite consists principally of titanic acid or oxyd and lime. Before the blowpipe alone it is infusible. With salt of phosphorus and borax, the pulverized mineral forms a clear glass colored with titanium; with the former in the inner flame the globule, as long as it is heated, is grayish-green, but becomes of a violet-blue on cooling; in the outer flame, it is greenish-white while hot, and clear and colorless on cooling.

Obs. Perovskite occurs in crystals or druses of crystals, the largest individuals of which yet seen are not over three lines in length. It is associated with finely crystallized chlorite, and magnetic iron in chlorite slate, at Achmatovsk near Slatoust in the Ural. But few specimens have yet been found. It is named in honor of vice president Von Perovski of St. Petersburg.

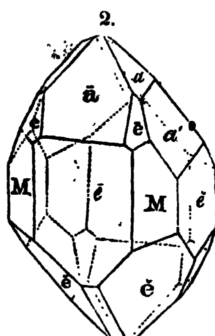
MONAZITE. Rutilus acrotomus.

Breithaupt, pp. 239 and 330. Mengite, *Brooke*, Phil. Mag. 1831, x, 189. Edwardsite Eremite, *Shepard*, Silliman's Jour. xxxii, 162, 341.

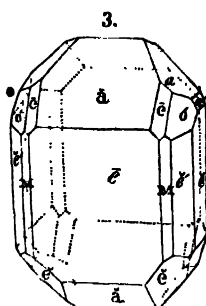
Primary form, an oblique rhombic prism; M : M=93° 10′, P : M=100°—100° 25′. *Secondary forms:* ē : ā=140° 40′, ē : ā=126° 8′, ē : a=131° 52′, ē : a′=150° 50′ ē : ē (over ā)=119° 22′, ĕ : ĕ (over ă)=106° 36′, o′ : o′ (over ā)=81° 4′, M : ē′=161° 16′, M : ē=136° 35′, M : ĕ=133° 25′, ē : P (cleavage plane) =103° 46′.



Norwich, Ct.



Watertown, Ct.



Watertown, Ct

These angles were afforded the author by the crystal represented in figure 3. Descloiseaux obtained for the foreign monazite, M : ē= 136° 30′, ē : P=104° 30′, ē : ă=126°, ē : ā=141° 5′. *Cleavage* perfect parallel with P; also parallel with the longer diagonal.

H.=5. G.=4·8—5·079. *Lustre* vitreous, or inclining to resinous. *Color* brownish-hyacinth-red, clove-brown, or yellowish-brown. Subtransparent—subtranslucent. Rather brittle.

Composition, according to Kersten, (Pogg. xlix, 228,) Oxyd of cerium 26·00, oxyd of lanthanum 23·40, thorina 17·95, oxyd of tin 2·10, protoxyd of manganese 1·86, lime 1·68, titanic acid and potash *a trace*, phosphoric acid 28·50=101·49, (Ural.) Tin was detected in this species by Rose, with the blowpipe.

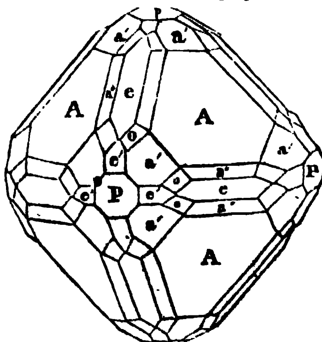
Fusible with difficulty on the edges, or infusible, becoming gray, or greenish-yellow. With borax, it slowly dissolves and forms a globule, which is bright yellowish-green or yellowish-red while hot, and colorless when cold. Decomposed by muriatic acid, evolving chlorine.

Obs. Monazite was first brought by Fiedler from the Ural. It occurs near Slatoust in granite, along with flesh-red feldspar. In the United States it is found in small crystals from one sixteenth to three fourths of an inch long, with the Sillimanite of Norwich, and sparingly with the same mineral at Chester, Ct. A few minute crystals (the Eremite of Shepard) were found by Mr. Thomas R. Dutton in a boulder of albitic granite, containing also a few minute zircons and tourmalines, in the northeastern part of Watertown, Conn. Good crystals are obtained with the Sillimanite of Yorktown, Westchester Co., N. Y.

RED COPPER ORE. Cuprius octahedrus.

Octahedral Copper-Ore, *M.* Red Oxyd of Copper. Oxydulated Copper, *P.* Tile Ore. Rothkupfererz, Ziegelerz, *W.* Cuivre Oxidé Rouge, Cuivre Oxidulé, *H.*

Primary form, the regular octahedron. *Secondary forms*: figs. 2, 3, 5, 6, 7, 8, 9, 10, 11, &c., Pl. I, also several of these forms in combination, as in the annexed figure. *Cleavage* parallel to A. *Imperfect crystallizations*: structure granular; particles of various sizes occasionally impalpable. Sometimes earthy.



H.=3·5—4. G.=5·992, Haidinger. *Lustre* adamantine, or submetallic—earthy. *Streak* several shades of brownish-red. *Color* red, of various hades, particularly cochineal-red;

occasionally crimson-red by transmitted light. Subtransparent—subtranslucent. *Fracture* conchoidal, uneven. Brittle.

Composition, Copper 88·88, and oxygen 11·12. Before the blowpipe in the reducing flame, on charcoal, affords a globule of copper. Dissolves with effervescence in nitric acid.

OBS. *Tile ore* formerly included the earthy varieties. These usually present a brick-red or reddish-brown color, and are frequently mixed with oxyd of iron. They occur in the Bannat, at Camsdorf and Saalfield, in Thuringia, and in Cornwall. Fine translucent crystals of red copper ore occur with native copper and quartz at Wheal Gorland and other Cornish mines. Isolated crystals, sometimes an inch in diameter, are found imbedded in lithomarge at Chessy, near Lyons: they are generally coated with malachite. Splendid specimens are brought from the Bannat and Ekatherinenburg in Siberia. Cornwall and Rheinbreitenbach, on the Rhine, afford the *capillary* variety, which occurs in extremely slender crystals, reticularly aggregated, often fibrous and flocculent. This is the *chalcotrichite* of Breithaupt, the *Kupferbluthe* or *Haarformiges Rothkupfererz* of other German authors, and is supposed to contain Selenium.

It has been observed crystallized and massive at Schuyler's, Somerville and Flemington copper mines, N. J., associated with chrysocolla and native copper; also in red shale near New Brunswick, N. J., and with green malachite in trap, two miles from Ladenton, Rockland Co., N. Y.

When found in large quantities, this species is valuable as an ore of copper.

BLACK COPPER. CUPRICUS OCHRACEUS.

Black Oxyd of Copper, *Th.* Copper Black, *J.* Black Copper, *P.* Kupferschwärze, *W.*

Disseminated, or coating other copper ores, in shining botryoidal concretions, or dull friable masses. *Color* black or brownish-black. Friable, and soils the fingers.

Composition, Oxygen 20·175, copper 79·825. Seldom pure in nature.

Before the blowpipe it is infusible. With borax it affords a greenish slag.

OBS. It occurs in most of the Cornish mines, particularly at the Carravat and Zincroft mines, accompanying copper pyrites, vitreous copper, and other ores of the same metal, and probably results from the decomposition of some of them.

RED ZINC ORE. ZINCUS BRUCII.

Prismatic Zinc-Ore, *M.* Red Zinc, Red Oxyd of Zinc. Manganesian Oxyd of Zinc. Zinkoxyd, *L.* Zinc Oxyde Ferrifère Brun Rougeâtre, *H.* Rothzinkerz.

Primary form, a right rhombic prism; M : M 125°. *Cleavage:* basal, eminent. *Imperfect crystallizations:* structure foliated; granular—particles strongly coherent.

H.=4—4·5. G.=5·432—5·523. *Lustre* subadamantine. *Streak* orange-yellow. *Color* deep red, also inclining to yellow. Translucent—subtranslucent. *Fracture* subconchoidal. Brittle.

Composition, according to Berthier, (Ann. des M. iv, 483,) Oxyd of zinc 88, and sesquioxyd of manganese 12. It is infusible, *per se*, before the blowpipe; with borax it yields a yellow transparent glass. It dissolves without effervescence in nitric acid. On exposure to the air, it suffers a partial decomposition at the surface, and becomes invested with a white coating, which is carbonate of zinc.

OBS. It occurs with Franklinite, and also with calcareous spar, at Franklin and Sterling, N. J. It was first noticed, described, and analyzed, by Dr. Bruce, (Bruce's American Mineralog. Journ., vol. i, p. 96.)

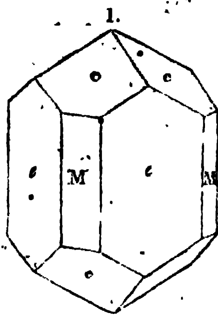
Mitscherlich has observed some minute six-sided prisms in the iron furnaces of Konigshutte, in Silesia, which he believes to be identical with this species.

This is a valuable ore of zinc when pure, and is easily reduced

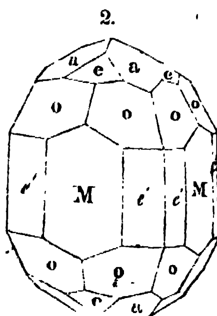
TIN ORE. JOVIS QUADRATUS.

Pyramidal Tin Ore, *M.* Oxyd of Tin. Peroxyd of Tin, *Thom.* Tin Stone. Wood Tin. Stream Tin. Kornisch Zinnerz, Zinnstein, *W.* Etain Oxydé, *H.*

Primary form, a right square prism. *Secondary forms:* M : e



Cornwall.



Cornwall.

=133° 38′, e : e=121° 35′, *e* : a=124°, e : a=150° 47′, a : a (over terminal edge)=132° 53′, a : a (over summit)=112° 1′, o : o=159° 6′ and 118° 16′, *e′* : *e′*=112° 37′ and 157° 23′. *Cleavage* indistinct parallel with M and *e*. *Compound crystals :* fig. 2, p. 66, composition of the *third kind*, or parallel to the plane a; fig. 12, Pl. IV, composition of the third kind; effected subsequent to the commencement of the formation of the crystals. *Imperfect crystallizations:* structure fibrous divergent, small reniform shapes; granular—particles of various sizes, sometimes impalpable.

H.=6—7. G.=6·5—7·1; 6·96, crystallized variety; 6·514, thin columnar variety. *Lustre* adamantine. *Streak* pale gray; in some varieties pale brown. *Color* mostly brown or black; sometimes red, gray, white, or yellow. Nearly transparent—opaque. *Fracture* subconchoidal, uneven. Brittle.

Composition, according to Klaproth, (Beit. ii, 256,) Thomson, (Min. i, 586,) and Berzelius, (Afhand. iv, 164,)

		Cornwall.	Finbo.
Peroxyd of tin,	99·00	96·265	93·6
Oxyd of columbium,	——	——	2·4
Peroxyd of iron,	0·25	3·395	1·4
Sesquoxyd of manganese,	——		0·8
Silica,	0·75	0·750	
	100·00, K.	100·410, T.	98·2, B.

Before the blowpipe, on charcoal, it is reducible, but with difficulty; reduction takes place more rapidly if mixed with borax and carbonate of soda. Infusible in acids. Fused with caustic potash it yields a mass which is mostly soluble in water; hydriodic acid throws down from the solution a yellow precipitate.

OBS. Tin ore is met with in veins traversing granite, gneiss, and mica slate.

Cornwall affords the finest and most remarkable simple crystals, associated with fluor, apatite, topaz, blende, wolfram, &c. The singular compound crystals come mostly from

Bohemia and Saxony. The twin forms from Zinnwald and Schlackenwald often weigh several pounds. It is, however, found in the greatest abundance at Cornwall, though in [illegible]

vicinity of Fahlun, where it occurs associated with topaz, albite, and quartz, contain, according to Berzelius, several per cent. of the oxyd of columbium. This is the *columbiferous oxyd of tin* described by Phillips.

The *fibrous* or *wood tin* occurs in botryoidal and reniform shapes of a radiated structure, and composed of concentric coats, and is found in Cornwall and Brazil. *Toad's eye tin* is the same, on a small scale. *Stream tin* is the alluvial debris of tin veins which is separated from the gravel by washing. It occurs in the low grounds of Cornwall.

The United States have afforded a few small crystals of tin at Chesterfield and Goshen, Mass., associated with albite and tourmaline; also at Lyme, N. H., and more abundantly on the estate of Mr. Eastman, in the town of Jackson, N. H., where it was discovered by Dr. C. T. Jackson, giving promise that valuable mines may yet be opened. It has also been observed sparingly in some of the gold mines of Virginia, by Prof. Rogers, imbedded in a talco-micaceous slate.

Pseudomorphs, imitative of feldspar, (a common mineral in the region,) have been found in Cornwall; and others composed of the white oxyd of tin, imitative of quartz.

The Cornwall mines have been worked from a very remote antiquity. The Tyrians, as early as the time of Moses, appear to have exported tin from this region. They afford annually about 6000 tons of tin, amounting in value to £400,000.. The purest grain tin is obtained from the stream ore, which often yields 70 per cent. The block-tin is smelted from the ore dry from the veins.

Iron coated with tin constitutes the ordinary tin ware. Mixed with mercury, it is used for the metallic covering of mirrors. With lead it forms pewter.

CERITE. CERITUS RHOMBOHEDRUS.

Rhombohedral Cerium-Ore. Siliciferous Oxyd of Cerium, Silicate of Cerium. Cererite. Ochroite. Cerinstein, *W.*

Primary form, hexagonal. Massive; structure granular. H.=5·5. G.=4·912, Haidinger. *Lustre* adamantine. *Streak* grayish-white. *Color* between clove brown and cherry-red, passing into gray. Slightly subtranslucent. *Fracture* splintery.

Composition, according to Hisinger (Afhand. iii, 283) and Vauquelin, (Ann. des M. v, 412,)

Oxyd of cerium,	68·59	67
Silica,	18·00	17
Peroxyd of iron,	2·00	2
Lime,	1·25	2
Water and carbonic acid,	9·60=99·44, H.	12=100, V.

It is infusible, *per se*, before the blowpipe; with borax in the outer flame it forms a yellow globule, which becomes almost colorless on cooling.

Obs. It occurs at Bastnaes, near Riddarhyttan in Westmanland, Sweden, forming a bed in gneiss, and associated with mica, hornblende, copper pyrites, cerine, &c. It bears considerable resemblance to the red granular variety of corundum, but is readily distinguished by its hardness.

SILICATE OF CERIUM. CERITUS WOLLASTONII.

Wollastonite. Brewster's Jour. vi, 357.

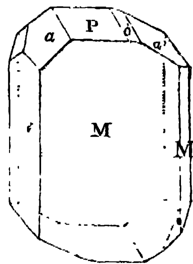
Primary form, a hexagonal prism. *Cleavage* parallel to the axis of the prism.

Color pale yellowish brown. Translucent.

OBS. Accompanies emerald in magnesian carbonate of lime, at Santa Fe de Bogota in Peru. Some fragments, associated with emerald, are preserved in the British Museum.

ALLANITE. MELANIUS PICEUS.

Anorthitic Melane-ore, *Haid.* Tetarto-prismatic Melane-ore, *M.* Prismatic Cerium-ore, *P.* Cerine, *Hisinger*, (1811.) Orthite, *Berz.*, (1815.)



Primary form, an oblique rhombic prism; M : M=128°, Rose; 129°, Haidinger. *Secondary*,—acute and obtuse lateral edges truncated, (planes $\bar{e}$ and $\breve{e}$,) also the lateral solid angles replaced by two or more planes, (a and a', fig. 98 Pl. II;) M : $\bar{e}$=154°, M : $\breve{e}$=116°. *Cleavage* in traces parallel with M. *Imperfect crystallizations:* massive, and in angular or rounded grains; compact, or crumbling: also in acicular aggregations.

H.=5·5—6. G.=3·3—3·8. *Lustre* submetallic and pitchy or resinous—occasionally vitreous. *Streak* gray, greenish, or brownish-gray. *Color* pitch-brown, brownish-black. Subtranslucent—opaque. *Fracture* uneven or subconchoidal. Brittle.

This species includes three varieties:

Allanite. Presents in general the above characters. G.=3·53—3·54, from Jotun Field; 3·79, from Snarum. Occurs in crystals, and in masses or grains, with or without traces of crystallization.

Cerine. In crystals and crystalline masses. H.=6. G.=3·77—3·8, Hisinger. *Lustre* weak, greasy. *Color* brownish-black. In thin splinters subtranslucent.

Orthite. Occurs in acicular crystals; also massive. *Lustre* vitreous, inclining to greasy. H.=5—5·75. G.=3·288; 3·63—3·65, from Fillefield. *Streak* gray. *Color* pitch-brown. *Fracture* imperfectly conchoidal. In very thin splinters subtranslucent.

These varieties have been lately examined by Scheerer, (Pogg. li, 407, 465, and lvi, 479,) and the following analyses are by him, with the exception of the Greenland Allanite, by Stromeyer.

	Allanite. Jotun Field.	*Allanite,* Snarum.	*Cerine,* Riddarhyttan.	*Orthite,* Fillefield.	*Allanite,* Greenland.
Silica,	35·15	35·75	32·06	34·93	33·02
Alumina,	16·23	15·49	6·49	14·26	15·22
Prot. iron,	15·55	15·19	Perox. 25·26	Prot. 14·90	15·10
Prot. cerium,	13·34	19·96	23·80	21·43	21·60
Ox. lanthanum,	5·80		2·45		
Prot. mang.	0·98	——	——	0·86	0·40
Magnesia,	0·78	0·77	1·16	0·85	——
Lime,	12·02	11·25	8·08	10·42	11·08
Water,	0·50	——	0·60	0·52	3·00
Yttria,	——	——	——	1·91	——
	100·35	98·41	99·90	100·08	99·42, Strom.

Beck found the Allanite of Orange Co. to consist of Protoxyd of cerium 24·90, silica 30·50, alumina 11·25, protoxyd of iron 22·27, lime 9·87; sp. gr. 3·6—3·65, (Min. N. Y., p. 441.)

Fuse before the blowpipe to a black glassy globule or pearl.

OBS. These varieties occur in albitic and common feldspathic granite, zircon-syenite, porphyry, and white limestone.

Allanite was brought from Greenland by Giesècké, and first distinguished as a species by Allan. It occurs there in granite. At Jotun Field in Norway, it is found in a kind of

porphyry, and at Snarum in albite along with rutile and apatite. The Allanite from Jotun Field gelatinizes with acids, while that from Snarum is not affected by acids.

Cerine occurs at Bastnäs in Sweden with hornblende and copper pyrites.

Orthite occurs in acicular crystals sometimes a foot in length; at Finbo near Fahlun in Sweden; at Skeppolm in black vitreous masses disseminated through granite; also at Lindenäs in Norway, and at Miask in the Ural. It was brought from Greenland by Giesecké. The name is derived from *ορθος, straight.*

In the United States, Allanite has been found in large crystals in Allen's vein at the gneiss-quarries, Haddam, Conn.; in small crystals at the Bolton quarry, Mass.; at South Royalston in boulders; at Athol on the road to Westminster in gneiss; a massive variety occurs in Monroe, Orange Co., New York, in a vein of feldspar and quartz.

Ural-Orthite. This mineral has nearly the composition of the orthite of Finbo. Berzelius obtained in his analysis of it, Silica 35·49, lime 9·25, alumina 18·21, oxyd of cerium and lanthanum 17·39, protoxyd of iron 13·03; oxyd of manganese 2·37, magnesia 2·06, water 2·00=99·80. Strongly heated, the edges fuse to a black blebby glass. Hardness nearly 6. G.=3·41. *Lustre* resinous. *Color* dark-brown. Occurs with small crystals of zircon in a flesh-red feldspar at Miask in the Ural, (Leonh. u. Br. N. Jahrb. 1842, p. 854.)

THORITE. MELANIUS THORIFERUS.

Berzelius, Kong. Vet. Acad. Handl. 1829, p. 1.

Massive and compact.

Not scratched by the knife. G.=4·63. *Lustre* of the surface of fresh fracture, vitreous; of exposed surface, resinous and dull. *Streak* dark brown. *Color* black, sometimes inclining to brown. *Fracture* conchoidal. Easily frangible.

Composition, according to Berzelius, Thoria 57·91, silica 18·98, lime 2·58, peroxyd of iron 3·40, oxyd of manganese 2·39, magnesia 0·36, water 9·50, with small portions of oxyds of lead and tin, peroxyd of uranium, potash, soda, and alumina.

Before the blowpipe it gives out water and becomes pale brownish-red, but does not fuse. Calcined in a tube it gives slight indications of fluoric acid. With carbonate of soda on platinum foil, it becomes green. It fuses easily with borax to a glass colored by iron.

OBS. It was found in syenite by M. Esmark, near Brevig, in Norway. It is stated to resemble Gadolinite in external characters. The new metal Thorium, was first discovered in this mineral by Berzelius.

PYRORTHITE. MELANIUS FLAMMANS.

In long thin imbedded crystals, without any distinct form; usually aggregated.

H. below 3. G.=2·15–2·25. *Lustre* resinous. *Streak* and *color* brownish black; if weathered, yellowish-brown. Opaque. *Fracture* conchoidal, splintery, earthy.

Composition, according to Berzelius, (Afhand. v, 49,) Silica 10·43, protoxyd of cerium 13·92, carbon 31·41, water 26·50, protoxyd of iron 6·08, yttria 4·87, alumina 3·59, lime 1·81, protoxyd of manganese 1·39=98·39.

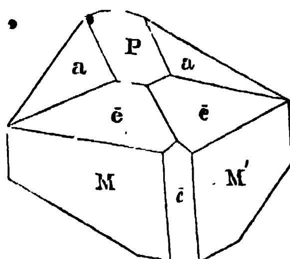
It takes fire when gently heated, and burns without either flame or smoke. Subsequently it whitens, and fuses to a black enamel. With borax it affords a transparent glass. In heated acids it dissolves with the exception of a black powder.

OBS. Pyrorthite occurs in a vein of granite, traversing gneiss, at Karafvet, near Fahlun, in Sweden, associated with Gadolinite. It resembles the orthite of the same region, except in its low degree of lustre.

The name of this species alludes to its burning, and is derived from *πυρ, fire*, and *orthite.*

GADOLINITE. MELANIUS OBLIQUUS.

Hemi-prismatic Melane-ore, *Haid.* Gadolinit, *W.*



Primary form, an oblique rhombic prism; M : M=115°, as determined with the common goniometer by Phillips; according to Haüy, 109° 28′. *Secondary form:* M : ē=153°, ē : ē=120°, (Phillips.) *Cleavage* very indistinct. Massive; impalpable.

H.=6·5—7. G.=4·14—4·3; 4·1795, Thompson; 4·238, Haidinger; 4·35, (from Hitterön,) Scheerer. *Lustre* vitreous, inclining to resinous. *Streak* greenish-gray. *Color* black or greenish-black. Subtranslucent—opaque. *Fracture* conchoidal.

Composition, according to Richardson (Thom. Min. i, 410) and Scheerer, (Pogg. lvi, 482,)

		From Hitterön.
Silica,	24·65	25·59
Glucina,	11·05	10·18
Yttria,	45·20	44·96
Lanthania,	——	6·33
Prot. iron,	14·55	12·13
Lime,	——	0·23
Prot. cerium,	4·60	——
Moisture,	0·50=100·55, R.	——=99·42, Sch.

As Richardson's analysis was made before the discovery of the metal lanthanum, it is probable that he has mistaken it for cerium, which Scheerer did not detect in his analysis.

It decrepitates in the blowpipe flame, and fuses when in thin splinters; heated with caution on charcoal, it exhibits a vivid glow, and the color becomes paler. It loses its color in heated nitric acid, and is converted into a jelly.

OBS. Gadolinite occurs principally in the quarries of Karafvet and Finbo, near Fahlun in Sweden; also at Ytterby, near Stockholm. At each locality it occurs indistinctly crystallized, and in rounded masses, which are often encircled with a yellow crust and imbedded in a coarse-grained granite. At Karafvet, crystals have been obtained four inches long. It has also been met with at Disko in Greenland, and imbedded in granite in Ceylon.

This mineral was first noticed by Capt. Arhenius, at Ytterby, and analyzed by M. Gadolin, who discovered in it a new earth, which was afterwards named *yttria,* from its locality, Ytterby. It occurs also at Finbo and Broddbo, and at Hitterön in the southern part of Norway.

Tschewkinite. This species, lately established by G. Rose, (Pogg. xlviii, 551,) is allied in external characters to Gadolinite, Allanite, &c. It occurs massive, with flat conchoidal fracture. *Color* velvet-black. Opaque or subtranslucent; edges by transmitted light, brown. H.=4—4·5. G.=4·508—4·549.

Reddens at once before the blowpipe, intumesces and turns brown, and at last fuses to a black globule. With borax, in powder, forms readily a clear glass, faintly colored with iron; more slowly soluble with salt of phosphorus, with the same result. Fuses with soda, but is absorbed by the charcoal. According to Rose, the mineral appears to consist of silica, oxyd of lanthanum, and protoxyd of cerium and iron, with traces of lime, magnesia, alumina, and yttria.

TITANIFEROUS CERITE. MELANIUS LAUGIERI.

Laugier, Ann. de Chim. et de Phys. xxvii, 313.

H.=6·5—7. *Lustre* vitreous. *Color* blackish-brown. *Fracture* conchoidal.

Composition, Oxyd of cerium 36·5, oxyd of iron 19·8, lime 8, alumina 6, water 11, oxyd of manganese 1·2, silica 19, oxyd of titanium 8; the excess above 100 of the sum of these quantities, has arisen from a change of the protoxyd of cerium to a peroxyd, during the analysis. It swells up when heated, and is attacked both by acids and alkalies.

OBS. It has been found on the Coromandel coast.

ÆSCHYNITE. MELANIUS MENGII.

Dystome Melane-Ore, *M.* Æschynite, *Berz.* Jahresb. ix, 195. Æschenite, *Brooke* Ann. of Phil. x, 188. *Leonhard.*

Primary form, an oblique rhombic prism of 127°, Brooke; 129°, Descloiseaux. *Secondary* similar to figure 98, Plate II, with the acute lateral and basal edges replaced; M : ē=115° 30′, ē: ē=143°, M : *a*=110° 7′, Descloiseaux.

H.=5—6. G.=5·14—5·66. *Lustre* resinous—submetallic. *Streak* dark gray, almost black. *Color* nearly black, inclining to brownish-yellow when translucent. Translucent—opaque. *Fracture* small subconchoidal.

Composition, according to Hartwall, (Pogg. xvii, 483,) Titanic acid 56, zirconia 20, peroxyd of cerium 15, lime 3·8, peroxyd of iron 2·6, oxyd of tin 0·5. Before the blowpipe, on charcoal, it swells and becomes yellow; with borax it readily forms a dark-yellow glass; with salt of phosphorus it yields a transparent colorless bead.

OBS. This mineral was brought by Menge from Miask in the Ural, where it occurs imbedded in feldspar, and associated with mica and zircon. The name *Æschynite* is derived from αἰσχύνη, *shame*, and was given this mineral by Berzelius, in allusion to the inability of chemical science, at the time of its discovery, to separate the two unlike substances, titanic acid and zirconia.

ŒRSTEDITE. MELANIUS QUADRATUS.

Œrstedite, *Forchhammer.*

Primary form, a right square prism. *Secondary form*, the primary with the angles and edges replaced; a : a=123° 16½′.

H.=6·5. G.=3·629. *Lustre* splendent. *Color* brown.

Composition, Titanate of zirconium 68·965, silica 19·708, lime 2·612, magnesia 2·047, protoxyd of iron 1·136, water 5·332=99·80, (Pogg. xxxv, 630.)

OBS. It occurs in brilliant highly modified crystals at Arendal, Norway, and is commonly found upon crystals of pyroxene. This species was discovered by Forchhammer, and named in honor of Œrsted.

MOSANDRITE.

Erdmann, Jahresb. xxi, 178.

Flat prisms. Also massive and fibrous. *Cleavage* in one direction distinct, in others indistinct.

H.=4. G.=2·93—2·98. *Lustre* of cleavage face between vitreous and greasy; of other surfaces resinous. *Color* dull reddish-brown. *Streak-powder* grayish-brown. Thin splinters translucent, and showing a bright red color by transmitted light.

According to Erdmann it consists mostly of silica, titanic acid, and oxyds of cerium and lanthanum, together with some oxyd of manganese, lime, a little magnesia and potash, and water. Before the blowpipe yields pure water, becomes brownish-yellow, and fuses easily with intumescence to a brownish-yellow shining pearl. With borax it dissolves easily and forms an amethystine pearl, which becomes yellowish and colorless in the reduction flame.

Obs. Occurs with albite, titanic iron, and violet fluor-spar, at Lammanskaret in Sweden. It was named by Erdmann, in honor of Mosander.

POLYMIGNITE. Melanius rectangulus.

Berzelius, K. V. Ac. H. 1824, p. 338, Brewster's Jour. iii, 329. Prismatic Melane-ore, *M.*



Primary form, a right rectangular prism. *Secondary form:* a : a=136° 28′, and 116° 22′, M : e=144° 53′. *Cleavage* in traces parallel to M̄ and M̆. The crystals are generally slender and thin, and striated longitudinally.



H.=6·5. G.=4·77—4·85. *Lustre* submetallic, but brilliant. *Streak* dark-brown. *Color* black. Opaque. *Fracture* perfect conchoidal, presenting, like the surface, a brilliancy almost metallic.

Composition, according to Berzelius, Titanic acid 46·3, zirconia, 14·14, peroxyd of iron, 12·2, lime 4·2, sesquoxyd of manganese, 2·7, peroxyd of cerium 5·0, yttria 11·5. Alone, the blowpipe produces no effect; with borax, it fuses readily to a glass, colored by iron. The addition of more borax renders it opaque and orange-colored.

Obs. It occurs at Fredericksvärn and Stavearn, in Norway, imbedded in feldspar and zircon-syenite. Its crystals sometimes exceed an inch in length. It has been detected by Prof. C. U. Shepard at Beverly, Mass.

It was named by Berzelius, in allusion to the number of substances that enter into its composition, from πολὺς, *many*, and μιγνύω, *to mix*.

WÖHLERITE. Columbius Wöhleri.

Wohlerit, *Scheerer*, Pogg. lix, 327, 1843.

In tabular crystals; form undetermined. Also granular. *Cleavage* distinct in one direction.

H.=5·5. G.=3·41. *Lustre* vitreous, inclining to resinous on a surface of fracture. *Color* light-yellow, wine-, honey-, and resin-yellow, brownish, grayish. *Streak-powder*, yellowish-white. Transparent—subtranslucent. *Fracture* more or less conchoidal—splintery.

Composition, according to Scheerer, Silica 30·62, columbic acid 14·47, zirconia 15·17, peroxyd of iron 2·12, protoxyd of manganese 1·55, lime 26·19, magnesia 0·40, soda 7·78, water 0·24=98·54. Dissolves easily in strong muriatic acid, with a separation of the silica and columbic acid. In a strong heat, fuses to a yellowish glass. With the fluxes, gives the reaction of manganese, iron, and silica.

Obs. Wöhlerite occurs with elæolite in zircon-syenite, on the island of Langesundfjords, near Brevig, in Norway.

PYROCHLORE. Columbius octahedrus.

Octahedral Titanium-Ore, *M.* Pyrochlore, Brewst. Jour. vi, 358. Microlite, *Shepard*, Sill. Am. Jour. xxvii, 361, xxxii, 338, xliii, 116.

Primary form, the regular octahedron. *Secondary forms*: figs. 9 and 17, Plate I. Octahedral *cleavage* sometimes distinct, especially in the smaller crystals.

H.=5—5·25. G.=3·802, (Pyrochlore from Brevig,) Berzelius; 4·32, (P. from Miask,) Rose; 4·203—4·221, (P. from Fredericksvärn,) Hayes; 5·48—5·562, (Microlite from Chesterfield,) Shepard. *Lustre* vitreous or resinous. *Color* pale honey-yellow, brown, dark-reddish or blackish-brown. Subtransparent—opaque. *Fracture* conchoidal.

Composition of Pyrochlore, according to Wöhler, (Pogg. xlviii, 83,) and A. A. Hayes, (communicated to the author,) (Sill. Jour. xlvi, p. 164,)

	Pyrochlore, Miask.		Brevig.		Fredericksvärn.
Columbic acid,	67·376		67·021		53·10
Oxyds of cerium and thorium,	13·152		5·159	Titanic acid,	20·20
Lime,	10·984		9·877		19·45
Yttria,	0·808	Oxyd urani.	4·601		——
Protoxyd of iron,	1·285		1·329	Peroxyd,	2·35
Protoxyd of manganese,	0·146		1·688	Oxyd of urani. and mang., lead and tin,	1·20
Sodium,	3·930		——		
Fluorine,	3·233		——	Volatile matter lost at redness,	0·80
Water,	1·160		7·059		
Titanic acid, tin, and mag.,	*undetermined*		*undetermined*		——
	102·074, W.		97·797, W.		97·10

A separate examination for the alkaline and volatile constituents, gave Mr. Hayes the following results, (Sill. Jour. xlvi, 165,)

Columbic acid, (with lime and titanic acid,)	59·00
Lime,	16·73
Titanic acid,	18·33
Soda,	5·63
Oxyd of iron and uranium, &c.,	·70
Volatile matter,	·80=101·19

The microlite of Chesterfield, according to Shepard, (Sill. Jour. xxxii, 338,) and A. A. Hayes, (Sill. Jour. xlvi, 162,) consists of

Columbic acid,	75·70		79·60
Lime,	14·84		10·87
Peroxyd of iron,	——		0·99
Tungstic acid, yttria and protoxyd of uranium,	7·42	Oxyd of uranium and manganese,	2·21
Water,	2·04=100, S.	Lead, 1·60, Tin, 0·70=2·30=	95·97, H.

Mr. Hayes, who has lately examined, with the above results, the foreign pyrochlore and the microlite, considers this mineral essentially a *columbate of lime*, with titanic acid sometimes replacing part of the columbic. He detected but a trace of cerium in his analysis of the Fredericksvärn pyrochlore.

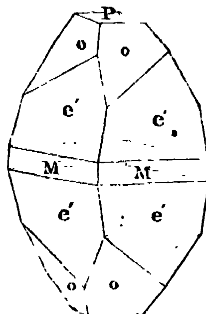
Before the blowpipe it becomes pale brownish-yellow or lemon-yellow, but retains its lustre, and fuses with great difficulty. Pyrochlore is stated to form with borax a reddish-yellow transparent globule in the oxydating flame, which, on flaming, becomes opaque; with more of the borax, it becomes a white enamel. With salt of phosphorus it dissolves completely, and at first, with some effervescence, forming a glass which in the outer flame is yellow while hot, but becomes grass-green on cooling. Microlite, according to Shepard, forms slowly a colorless transparent globule, with borax.

OBS. *Pyrochlore* occurs imbedded in syenite at Fredericksvärn and Laurvig in Norway, associated with zircon, polymignite, and phosphate of yttria; also at Brevig with thorite, and at the Ilmengebirge near Miask in Siberia. *Microlite* is associated with albite, green and red tourmalines, uranite, and columbite, in the Chesterfield vein, Mass.

Pyrochlore was so named by Berzelius, in allusion to its becoming yellowish-green under the blowpipe, from πυρ, *fire*, and χλωρος, *green*. Wöhler's original analysis made it a titanate instead of a columbate, in which respect it appeared to differ from the microlite of Prof. Shepard; but the more recent analyses have removed this discrepancy.

FERGUSONITE. COLUMBIUS HEMIQUADRATUS.

Haidinger, Edin. Trans. x, 274. Pyramidal Melane ore, *M.*



Primary form, a right square prism. *Secondary form*: o : o=100° 28′, e′ : e′=8 °. 6′, M : e′=169° 31′.

H.=5·5—6. G.=5·838, Allan; 5·800, Turner. *Lustre* externally dull, on the fracture brilliantly vitreous. *Streak* very pale brown. *Color* brownish-black; in thin scales it is pale liver-brown, or yellowish-brown. Subtranslucent—opaque. *Fracture* perfect conchoidal.

Composition, according to M. Victor Hartwall, (K. V. Ac. H. 1828, p. 167,)

Columbic acid,	47·75
Yttria,	41·91
Protoxyd of cerium,	4·68
Zirconia,	3·02
Oxyd of tin,	1·00
Oxyd of uranium,	0·95
Peroxyd of iron,	0·34=99·65

It is infusible before the blowpipe, but loses its color; with borax it fuses with difficulty, and forms a glass, which is yellow while hot, with some interspersed white spots of undissolved matter. With carbonate of soda it is decomposed and fuses, leaving a reddish slag.

OBS. It was discovered by Giesecké, near Cape Farewell, in Greenland, disseminated in quartz. It was named in compliment to Robert Ferguson, Esq., of Raith.

YTTRO-COLUMBITE. COLUMBIUS BERZELII.

Yttro-Tantalite. Tantale Oxidé Yttrifére, *H.* Discolumbate of Yttria, Triscolumbate and Tetracolumbate of Yttria, *Thomson*.

There are three varieties of this species; the *black*, the *yellow*, and the *brown* or *dark* yttro-columbite.

The *black* exhibits indistinct traces of crystallization. H.=5·5. G.=5·395. *Lustre* submetallic. *Streak* gray. *Color* black. Opaque.

The *yellow* never exhibits a crystalline form, but occurs in laminæ in the fissures of feldspar. H.=5. G.=5·882, Ekeberg. *Lustre* resinous on the surface, vitreous in the fracture. *Streak* white. *Color* yellowish-brown—greenish. Opaque.

The *brown* occurs with the yellow, in thin plates, or rarely grains, presenting no trace of crystallization. H.=4·5—5. *Lustre* vitreous, inclining to resinous. *Streak* white. *Color* black, with a very light shade of brown, slightly yellow when in thin plates by transmitted light.

Composition, according to Berzelius, (Afhand. iv, 268, 272,)

	Black.		Yellow.		Brown.
Columbic acid,	57·00		60·124		51·815
Yttria,	20·25		29·780		38·515
Tungstic acid,	8·25	With tin,	1·044	With tin,	2·592
Lime,	6·25		0·500		3·260
Peroxyd of iron,	3·50		1·155		0·555
Oxyd of uranium,	0·50=95·75		6·622=99·225		1·111=97·848

Each of these varieties is infusible alone before the blowpipe, but they decrepitate and assume a light color. The black variety froths, and fuses with carbonate of soda. They dissolve in borax, but are not acted upon by acids.

Obs. These varieties of yttro-columbite occur in Sweden at Ytterby, in red feldspar, and at Broddbo and Finbo, near Fahlun, imbedded in quartz and albite, and associated with garnet, mica, and the pyrophysalite variety of topaz. We are indebted to Berzelius for the discovery and description of them.

EUXENITE. Columbius Keilhaui.

Scheerer, Pogg 1, 149.

Massive, without any traces of cleavage.

Scratches thorite. G.=4·60. *Lustre* metallic, greasy. *Streak-powder* reddish-brown. *Color* brownish-black; in thin splinters has a reddish-brown translucence, lighter than the streak. *Fracture* subconchoidal.

Composition, according to Scheerer,

Columbic acid (with some titanic acid) 49·66, titanic acid 7·94, yttria 25·09, protoxyd of uranium 6·34, protoxyd of cerium 2·18, oxyd of lanthanum 0·96, lime 2·47, magnesia 0·29, water 3·97=98·90.

Infusible. With borax in the oxydation flame it becomes yellow or brownish-yellow, and the color is the same after cooling; and by flaming, it forms a yellowish enamel. The color is but little changed in the reduction flame. With salt of phosphorus it dissolves in the oxydation flame, forming a yellow pearl, which on cooling becomes colorless.

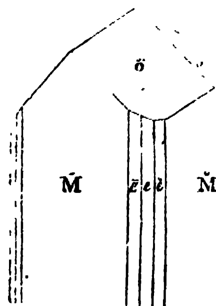
Obs. Euxenite comes from Jolster in Norway, where it was obtained by Prof. Keilhau. It was named by Scheerer from *ευξενος, a stranger*, in allusion to the rarity of its occurrence. It resembles yttro-columbite, but differs in specific gravity, and in containing titanic acid, cerium, and lanthanum, and also water

COLUMBITE. Columbius rectangulus.

Prismatic Tantalum ore, *J.* and *M.* Tantalit *of the Germans*. Tantale Oxide, *H.* Columbite, *Hatchett*.

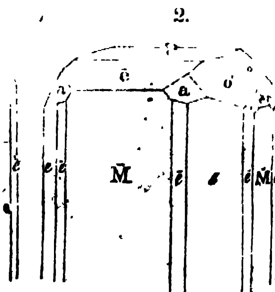
Primary form, a right rectangular prism. *Secondary forms:*

1.



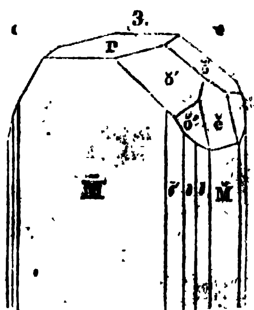
Haddam, Conn.

2.



Middletown, Conn.

3.



Bohemia.

M̄ : e=140° 20′, M̆ : e=129° 40′, M̄ : ē=157° 29′, M̆ : ĕ=158° 6′, M̆ : e =112° 31′, P : ē=160° 34′, P : ē=119° 40′, M : ĕ=109° 26′, M̆ : ĕ= 150° 20′, P : a=126° 2′, a : a (over ŏ′)=102° 58′, a : e=143° 58′, P : ŏ′=136° 36′, ŏ′ : ŏ′=150° 17′, a : ŏ′=156° 20½′, ŏ′ : ē=133° 24′, P : ŏ″=119° 13′, ŏ″ : ŏ″ (over ē)=160° 29′, ē : ŏ″=170° 14½′. The following angles were obtained by Brooke with the common goniometer, from a specimen supposed to have been found at Bodenmais in Bavaria: M̄ : ē=153° 6′, M̆ : ē=114° 30′, P : ĕ=120°, P : ŏ′= 136° 30′. Dr. Torrey found the angle M̄ : ē, of a crystal (fig. 1) from Haddam (Ann. New York Lyc. i, 89) to equal 157°, and M̆ : e =129° 50′. *Cleavage* parallel with M̄ and M̆ rather distinct, the former the more so; parallel with P indistinct. Occurs also massive; structure granular.

H.=5–6. G.=5·9—6·1, 5·948 from Haddam. *Lustre* submetallic. *Streak* dark brown, slightly reddish; brownish black; a little shining. *Color* iron-black, brownish-black, grayish-black. Opaque. *Fracture* subconchoidal, uneven. Brittle.

Composition, according to Borkowsky, Vogel, and Thomson,

	Bodenmais.	Bodenmais.	Middletown, Conn.	Bodenmais.
Columbic acid,	74·0	75	73·90	79·65
Protox. iron,	20·0	17	15·65	14·00
Protox. manganese,	4·6	5	8·00	7·55
Oxyd of tin,	0·4	1	——	0·50
Water,	—	—	0·35	0·05
	99·0, B.	98, V.	97·90, T.	101·75, T.

Dr. Wollaston obtained from four grains of the original specimen in the British Museum, sent out from Connecticut by Gov. Winthrop to Sir Hans Sloane, Columbic acid 80, protoxyd of iron 15, protoxyd of manganese 5=100.

Before the blowpipe alone, on charcoal, columbite is infusible. With borax, in powder fusion takes place slowly but perfectly.

Obs. Columbite of Bodenmais, Bavaria, and also of Rabenstein, near Zweisel, in Bohemia, occurs in granite. In the United States it occurs both in feldspathic and albitic granite.

The occurrence of columbite in this country was first made known by Mr. Hatchett's examination of a specimen, sent by Gov. Winthrop to Sir Hans Sloane, then President of the Royal Society, which was labelled as found at Neatneague. Dr. S. L. Mitchill stated (Med. Repos. vol. viii) that it was taken from a spring at New London, Conn. No locality has since been detected at that place. But the rediscovery of it at Haddam, first published by Dr. Torrey, (Silliman's Amer. Jour. iv, 52,) has led to the belief, that the latter was its original locality. It has since been discovered more abundantly near Middletown, Conn.

At Haddam it occurs in a granite vein, associated with chrysoberyl, beryl, and automolite. Much finer and larger crystals have been afforded by the Middletown locality, where it occurs in a feldspar quarry. The above figure, 2, represents one of these crystals three quarters of an inch long; its faces are sufficiently brilliant for the use of the reflecting goniometer. A crystal from this locality has been described by Professor Johnston, of the Wesleyan University of Middletown, (Silliman's Amer. Journal, xxx, 387,) which weighed, before it was broken, fourteen pounds. The part figured weighed six pounds and twelve ounces avoirdupois, and was about six inches in length and breadth. It exhibits the faces M̄, M̆, ē, ĕ′, ē, ĕ, and another imperfect plane, which appears to be ŏ′. Chesterfield, Mass., has afforded some fine crystals, associated with blue and green tourmalines, and beryl, in granite; also quite large and perfect crystalline individuals have been found at Acworth, N. H., but the locality is now apparently exhausted. It has also been observed at Beverly, Mass.

FERRO-TANTALITE. Columbium ferrosus.

Tantalite. Columbate of iron. Tamela-tantalite. Kimito Tantalite.



Kimito.

Primary form, a rectangular prism. *Secondary form:* M : e=122° 54′, M : e‴=152° 58′, e′ : e′ =167° 38′, ŏ′ : ŏ′ (adjacent)=126°, ŏ′ : ŏ′ (over e″)=112° 30′, ŏ′ : ŏ′ (planes at opposite extremities of the crystal)=91° 42′, ŏ″ : ŏ″ (adjacent)= 91° 59′, ŏ‴ : ŏ‴=73° 37′. Also massive.

H.=5—6. G.=7·236—7·963, Ekeberg. *Lustre* nearly pure metallic. *Color* iron black. *Streak* reddish-brown. Opaque. Brittle.

Composition, according to Berzelius and Nordenskiöld,

	Kimito.	Tamela.	Tamela.
Columbic acid,	83·2	85·85	83·44
Protoxyd of iron,	7·2	12·97	13·75
Protoxyd of manganese,	7·4	1·60	1·12
Oxyd of tin,	0·6	0·80	trace
Lime,	——	0·46	Loss, 1·69
Silica,	——=98·4, B	0·72=102·50, B.	——=100, N.

The Broddbo columbite contains a large proportion of tin, and has a specific gravity of 6·5. The following are the results of three analyses by Berzelius:

Columbic acid,	66·66	68·22	66·345
Oxyd of tin,	8·02	8·26	8·400
Tungstic acid,	5·78	6·19	6·120
Oxyd of iron,	10·64	9·58	11·070
Oxyd of manganese,	10·20	7·15	6·600
Lime,	——=101·30	1·19=109·59	1·500=100·035

Obs. Ferro-tantalite is confined mostly to albitic granite, and is usually associated with beryl. It occurs in Finland, both at Tamela and Kimito. In the Kimito tantalite, part of the iron is replaced by manganese. Near Harkasaari, ferro-tantalite is associated with rose quartz and gigantolite, in albitic granite. At Katiala it is associated with lithia mica, black tourmaline, and colorless beryl

URANOTANTALITE. Columbium uraniferum.

Uranotantal. *G. Rose.* Pogg. xlviii, 555.

In flattened grains, occasionally with traces of crystallization, H.=5·5. G.=5·625. *Lustre* of surface of fracture shining and submetallic. *Streak* dark reddish-brown. Opaque.

Heated lightly in a glass tube, it decrepitates, disengages a little moisture, and burns like gadolinite, becoming of a brownish-black color. In the platina forceps it melts on the edges to a black glass. On platina wire, with borax, the pulverized mineral fuses easily, and forms in the inner flame a yellow glass, and in the outer a yellowish-green glass.

The mineral is a columbate of the protoxyd of uranium.

Obs. Uranotantalite occurs in reddish-brown feldspar, with crystallized æschynite, in the Ilmen mountains, near Miask in the Ural. The largest pieces met with were of the size of hazle-nuts.

PITCHBLENDE. Uranius amorphus.

Uncleavable Uranium-Ore, *M.* Uranium-Ore, *M.* Uran-Ochre, *P.* Protoxyd of Uranium, Pecherz, *W.* Pechuran, *Haus.* Urane Oxydulé, *H.*

Massive and botryoidal; also in grains.

H.=5·5. G.=6·468. *Lustre* submetallic, or dull. *Streak* black, a little shining. *Color* grayish, brownish, or velvet-black. Opaque. *Fracture* conchoidal, uneven.

Composition, according to Klaproth, (Beit. ii, 221,) Protoxyd of uranium 86·5, protoxyd of iron 2·5, silica 5·0, sulphuret of lead 6·0.

Wöhler and Svanberg have lately found vanadium in this ore. Rammelsberg obtained for the composition of a specimen from the "Tanne" mine, Joachimstahl, Protoxyd of uranium 79·148, silica 5·301, lead 6·204, iron 3·033, lime 2·808, magnesia 0·457, arsenic 1·126, bismuth with traces of lead and copper 0·648, water 0·362=99·087. The silica he supposes to be united with the lime and protoxyd of iron, as in yenite. He found no traces of vanadium.

Alone, before the blowpipe, it is infusible: but with borax it melts to a gray scoria. In the state of powder, it dissolves slowly in nitric acid, evolving the red fumes of nitrous acid. It is not attractable by the magnet.

Obs. Pitchblende accompanies various ores of silver and lead at Johanngeorgenstadt, Marienberg, and Schneeberg in Saxony, at Joachimsthal and Przibram in Bohemia, and at Retzbanya in Hungary. It is associated with uranite in some of the Cornish mines

It is employed in porcelain painting, affording an orange-color in the enameling fire, and a black one in that in which the porcelain is baked.

WOLFRAM. Wolframius rectangulus.

Prismatic Scheelium-Ore, *M.* Tungstate of Iron. Tungstate of Iron and Manganese, Scheelate of Iron and Manganese. Scheelin Ferruginé, *H.*

Primary form, a rectangular prism. *Secondary form*: e′ : e′=101° 5′, ĕ : ĕ (over the apex)=125° 20′, ĕ : ĕ (over the apex)=99° 12′. *Cleavage* perfect parallel with M̄. *Compound crystals*: composition parallel to M̄; other twins occur in which composition takes place parallel to ĕ, or is of the *second kind*. *Imperfect crystallizations*: structure irregular lamellar; also coarse divergent columnar; granular—particles strongly coherent.—*Pseudomorphs* imitative of tungstate of lime.

H.=5—5·5. G.=7·1—7·4. *Lustre* submetallic. *Streak* dark reddish-brown. *Color* dark grayish or brownish-black. Opaque.

Composition, according to Berzelius, (Afhand. iv, 304,) Vauquelin, (Ann. of Phil., 2d ser., xi, 328,) and Schaffgotsch, (Pogg. lii, 475,)

			Ehrenfriedersdorf.	Chanteloupe. G.=7·437	Zinnwald G.=7·191
Tungstic acid,	74·666	73·151	75·89	76·00	75·66
Protoxyd of iron,	17·594	20·745	19·24	18·33	9·49
Protoxyd of mang.	5·640	5·744	4·97	5·67	14·85
Silica,	2·100	—	—	—	—
	100·000, B.	100·000, V.	100·00, S.	100·00, S.	100·00, S.

Wöhler states that wolfram contains oxyd of tungsten, instead of tungstic acid.*

It decrepitates before the blowpipe, and melts at a high temperature to a globule, whose surface is covered with crystals, having a metallic lustre. With borax it forms a green bead. With salt of phosphorus it fuses to a clear globule, of a deep red color.

Obs. Wolfram is often associated with tin ores; also with galena, in veins traversing gray-wacke; also in quartz, with native bismuth, tungstate of lime, pyrites, galena, blende, &c.

It occurs at Cornwall, much to the detriment of the tin ores; in fine crystals at Schlackenwald, Zinnwald, Ehrenfriedersdorf; also at Limoges, in France, and on the island of Rona, one of the Hebrides.

In the United States it occurs at Lane's mine, Monroe, Conn., in quartz, associated with native bismuth, and the other minerals above mentioned. Pseudomorphs, of the form of tungstate of lime, are often observed at this locality. It has also been met with in small quantities in Trumbull, Conn., at the topaz vein; also massive and in crystals on Camdage farm, near Blue Hill, Me.

HAUSMANNITE. Manganus acrotomus.

Pyramidal Manganese Ore, *M.* Foliated Black Manganese Ore, *J.* Black Manganese. Red Oxyd of Manganese. Blättriger Schwarz Braunstein, *Haus.* Manganese Oxyde Hydraté, *H.*

Primary form, a square octahedron. *Secondary form:* fig. 57, Pl. I; a : a=105° 25′, a : a (in different pyramids) =117° 54′, a′ : a′=139° 56′. *Cleavage* rather perfect parallel to the base of the octahedron. *Compound crystals:* somewhat similar to figure 129: the same kind of composition sometimes takes place between four individuals. *Imperfect crystallizations:* structure granular, particles strongly coherent.

H.=5—5·5. G.=4·722. *Lustre* submetallic. *Streak* chesnut-brown. *Color* brownish-black. Opaque. *Fracture* uneven.

Composition, according to Turner, (Edinb. Trans. xi,) Red oxyd of manganese 98·902, oxygen 0·215, water 0·435, baryta 0·111, silica 0·337=100.

In the oxydating flame of the blowpipe it affords an amethystine globule. Dissolves in heated muriatic acid, with the odor of chlorine.

Obs. It occurs with porphyry, in other manganese ores, in fine crystals, near Ilmenau in Thuringia, and at Framont in Alsatia. It has been observed at Lebanon, Penn.

BRAUNITE. Manganus peritomus.

Brachytypous Manganese-Ore, *M.* Anhydrous Sesqui-oxide of Manganese, *Thom.*

Primary form, a square octahedron of nearly the dimensions of the regular octahedron; A : A=109° 53′. *Secondary form:* similar to the last species. Occurs also massive.

H.=6—6·5. G.=4·818. *Lustre* submetallic. *Streak* and *color* dark brownish-black. *Fracture* uneven. Brittle.

Composition, according to Turner, (Edinb. Trans. xi,) Protoxyd of manganese 86·94, oxygen 9·851, water 0·949, baryta 2·260, and a trace of silica. It dissolves in muriatic acid, leaving a silicious residue.

Obs. It occurs both crystallized and massive, in veins traversing porphyry at Oehren-

* Schaffgotsch infers from his analysis that there are three distinct compounds of tungstate of iron and manganese, included under the name of wolfram. The Chanteloupe variety may possibly be identical with that from Ehrenfriedersdorf; but the Zinnwald Wolfram is obviously distinct. The proportion of acid to base in the wolfram from Ehrenfriedersdorf and Zinnwald is as 2 to 5; but in the former, there are 4 parts of tungstate of iron to 1 of tungstate of manganese; and in the latter, *three* of the one to *two* of the other. A wolfram from Monte Video (sp. gr.=7·544) gave the same result as that from Ehrenfriedersdorf.

stock, near Ilmenau, at Elgersburg, and elsewhere, in Thuringia; also with red epidote, at St. Marcel, in Piedmont. This species was named in honor of Mr. Braun, of Gotha.

PSILOMELANE. MANGANUS INFORMIS.

Uncleavable Manganese-Ore, *M.* Compact and Fibrous Manganese-Ore. Black Hematite. Compact Gray Oxyd of Manganese. Black Iron Ore Psilomelanite. Schwarzeisenstein, *W.* Fasriger and Dichter Schwarzbraunstein, *Haus.* Dichtes Schwarz-Manganerz, *L.* Manganese Oxidé Hydraté Concretionné, *H.*

Crystalline form has not been observed. Occurs massive and botryoidal.

H.=5—6. G.=4—4·328. *Lustre* submetallic. *Streak* reddish, brownish-black, shining. *Color* black, passing into dark steel-gray. Opaque. *Fracture* not observable.

Composition, according to Turner, (Edinb. Trans. xi,) Red oxyd of manganese 69·795, oxygen 7·364, baryta 16·365, silica 0·260, water 6·216=100. A specimen from Horhausen afforded Rammelsberg, (Pogg. liv, 551, 1841,) Protoxyd of manganese 9·50, superoxyd of manganese 81·01, potash 3·04, oxyd of copper 0·96, water 3·39=97·93, with traces of lime, soda, magnesia, and silica.

It gives a violet color to borax, and is completely soluble in muriatic acid, excepting a small quantity of silica.

OBS. This is one of the most generally diffused ores of manganese. It frequently occurs in alternating layers of different thickness, with pyrolusite. It occurs in botryoidal and stalactitic shapes, in Devonshire and Cornwall; at Ilfeld, in the Hartz; also in Hesse, Saxony, &c.

This species occurs also in mammillary and botryoidal masses, at Chittenden, Vt.

The name psilomelane is derived from ψιλος, *smooth* or *naked*, μελας, *black*, and was given it on account of its smooth botryoidal forms and black color. The *manganèse oxidé noir barytifère*, from Romanèche, has a somewhat higher specific gravity, but in other respects resembles this species.

CUPREOUS MANGANESE. MANGANUS CUPRIFERUS.

Kupfermanganerz *of the Germans.*

Massive, in small reniform and botryoidal groups.

H.=1·5. G.=3·15—3·25. *Lustre* resinous. *Streak* and *color* bluish-black. Opaque.

Composition, according to Lampadius, Black oxyd of manganese 82, brown oxyd of copper 13·50, silica 2. A cupreous manganese from Schlackenwald afforded Kersten, (Schweig. lxvi, 3,)

Peroxyd of manganese 74·10, oxyd of copper 4·80, peroxyd of iron 0·12, gypsum 1·05, silica 0·30, water 20·10=100·47.

Another from Kamsford near Saalfield, afforded Rammelsberg, (Pogg. liv, 547, 1841,)

Superoxyd of manganese 55·09, protoxyd of manganese 5·00, oxyd of copper 14·67, lime 2·25, baryta 1·64, protoxyd of cobalt 0·49, magnesia 0·69, potash 0·52, water 13·65.

Before the blowpipe it becomes brown, but does not fuse; to borax and salt of phosphorus it communicates amethystine and green colors, and the other characteristic indications of copper and manganese.

OBS. This rare mineral occurs in the tin mines of Schlackenwald in Bohemia; it was distinguished by Breithaupt and Lampadius.

MANGANITE. MANGANUS RHOMBICUS.

Prismatoidal Manganese-Ore, *M.* Gray Manganese-Ore. Gray Oxide of Manganese. Hydrous Sesquioxyd of Manganese, *Thom,* Graner Braunstein, *W.* Manganese Oxydé, *H.*

Primary form, a right rhombic prism; M : M=99° 40′. *Sec-*

ondary form and *twin crystal*, fig. 15, Pl. III; in this crystal composition is of *the third kind*, and has been effected parallel to the plane *a* on the acute solid angle. Other twins occur, composed of two individuals united by their acute lateral edges. Crystals longitudinally striated. *Imperfect crystallizations*: structure columnar; also granular.

H.=4—4·5. G.=4·3—4·4. *Lustre* submetallic. *Streak* reddish-brown, sometimes nearly black. *Color* dark steel-black—iron-black. Opaque; minute splinters cleaved off sometimes exhibit a brown color by transmitted light, when exposed to the direct light of the sun. *Fracture* uneven.

Composition, according to Turner Edinb Trans. 1828) and Gmelin, (Schweig. xxvi. 262.)

Red oxyd of manganese,	86·85	87·1
Oxygen,	3·05	3·4
Water,	10·10=100, T.	9·5=100, G.

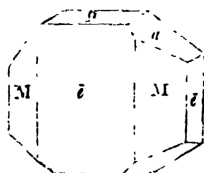
Before the blowpipe alone it is infusible; with borax it yields a violet-blue globule. Insoluble in nitric acid; in muriatic acid it gives off chlorine and dissolves without a residue.

Obs. It occurs in veins traversing porphyry, associated with calcareous spar and heavy spar, at Ilfeld, in the Hartz; also in Bohemia, Saxony, and Aberdeenshire. The gray oxyd from Undenaes, in West Gothland, analyzed by Arfvedson, is a similar compound.

It is important in the manufacture of glass, and in bleaching operations.

PYROLUSITE. Manganus prismaticus.

Prismatic Manganese Ore, *M.* Gray Ore of Manganese. Wad Anhydrous Binoxide of Manganese, *Turner*. Graubraunsteinerz.



Primary form, a right rhombic prism; M : M=93° 40′. *Secondary form*: M : ē=136° 50′, M : ĕ=133° 10′. *Cleavage* parallel to M and ē, ĕ. *Imperfect crystallizations*: structure columnar—often divergent; also granular; frequently in reniform coats; often soils when massive.

H.=2—2·5. G.=4·819, Turner; 4·97 when pure. *Lustre* metallic. *Streak* black. *Color* iron-black, sometimes bluish. Opaque. Rather sectile.

Composition, according to Turner (Edinb. Trans. 1828) and Thomson, (Min. i, 503,)

				Acicular crystals.
Red oxyd of manganese,	84·05	85·62		99·242
Oxygen,	11·78	11·60		
Water,	1·12	1·56		——
Baryta,	0·53	0·55	Perox. iron,	0·130
Silica,	0·51	0·66		0·840
	97·99, Turn.	99·99, Turn.		100·212, Th.

With borax it affords an amethystine globule: heated in a matrass, it yields no water.

Obs. This ore is extensively worked at Elgersburg, Ilmenau, and other places in Thuringia; also at Vordehrensdorf near Mährish-Trübau, in Moravia, which place annually affords many hundred tons of this ore. At each of these places it is associated with psilomelanite. The finest crystals occur at Schimmel and Osterfreude, near Johanngeorgenstadt, and at Hirschberg, in Westphalia.

In the United Sates it occurs, associated with psilomelane, abundantly in different parts of Vermont, at Bennington, Monkton, Chittenden, &c., both crystallized similar to the above figure, and massive. It is found at Conway, Mass., in a vein of quartz; also at Plainfield and West Stockbridge, Mass.; at Winchester, N. H.; at Salisbury and Kent, Conn., forming velvet-like coatings on brown iron ore.

Pyrolusite parts with its oxygen at a red heat, and is extensively employed for discharging the brown and green tints of glass. It hence received its name from πυρ, *fire*, and λυω, *to wash;* and for the same reason is whimsically entitled by the French, *le savon de verriers*. It is easily distinguished from psilomelane by its inferior hardness.

HETEROCLIN.

Heteroklin, *Breithaupt*. *Evreinoff*, Pogg. xlix, 204.

Primary form, an oblique rhombic prism; M : M=128° 16′. *Secondary*, the prism with the acute lateral edges truncated, two of the terminal edges replaced, (M : e=151° 37′,) and one of the front solid angles, (a : e=109° 36′.?) *Cleavage* in one direction not very distinct. Occurs also massive.

H.=6. G.=4·652, E. *Lustre* submetallic. *Streak* black, inclining to brown. *Color* iron-black, inclining a little to steel-gray. *Fracture* uneven to small conchoidal.

Composition, according to Evreinoff,

Silica,	10·30	10·02
Peroxyd of manganese,	85·86	85·88
Perox. iron,	3·72	3·05
Lime,	0·62	0·60
Potash,	0·44=100·94	0·44=99·99

Before the blowpipe acts like the peroxyd of manganese.

The species occurs at St. Marcel in Piedmont, mixed with manganesian epidote and quartz. It was first instituted by Breithaupt, and named from ἑτεροκλινής, in allusion to its oblique form of crystallization.

Berzelius obtained for a manganese ore from Piedmont, Silica 15·17, peroxyd of manganese 75·80, peroxyd of iron 4·14, alumina 2·80=97·91.

The *Marceline* of Beudant, which has a somewhat similar composition, is considered a mechanical mixture of Braunite in minute crystals with some earthy silicate of manganese; analysis afforded Silica 15·4, protoxyd of manganese 70·7, peroxyd of iron 1·0, alumina 1·0, oxygen 6·1, quartz 2·8=97·0.

EARTHY COBALT. Manganus cobaltiferus.

Earthy Cobalt, *P.* Erdkobold, *W.* Schwarzer Erdkobalt, *Haid.* Cobalt Oxide Noir, *H.*

Massive botryoidal, earthy and granular.

Soft. G.=2·24. *Lustre* somewhat resinous. *Streak* shining. *Color* bluish and brownish-black. Opaque. Sectile.

Composition, according to Rammelsberg, (Pogg. liv, p. 553, 1841,) Protoxyd of manganese 40·05, protoxyd of cobalt 99·45, oxyd of copper 4·35, peroxyd of iron 4·56, baryta 0·50, potash 0·37, oxygen 9·47, water 21·24=99·99.

Obs. Before the blowpipe it emits the odor of arsenic, but does not fuse. It colors glass of borax blue. The yellow variety is a mixture of hydrous arsenates of iron, cobalt, and lime, and results from the decomposition of white cobalt.

It occurs in sandstone, associated with lead and copper, at Alderly Edge, in Cheshire;

with green malachite at Nertschinsk in Siberia; with several species of cobalt pyrites at Reichelsdorf in Hesse, and Saalfield in Thuringia.

It is employed in the manufacture of smalt.

Its brilliantly shining *streak* is an important peculiarity, and may assist in distinguishing it.

WAD. MANGANUS TERRENUS.

Earthy Manganese. Bog Manganese. Groroilite, *Berthier*. Manganschaum.

In reniform, botryoidal, and arborescent shapes, and in froth-like coatings on other minerals; also massive.

H.=0·5. G.=3·7. *Lustre* dull, earthy. *Streak* and *color* brown or black. Opaque. *Fracture* earthy. Very sectile. Soils.

Composition, according to Klaproth, (Beit. iii, 311,) Oxyd of manganese 68, oxyd of iron 6·5, water 17·5, carbon 1·0, Baryta 1·0, and silica 8·0.

Beck has analyzed several varieties of wad from New York, and found them to vary much in composition. The following are some of his results, (Min. N. Y. p. 55.).

	Hillsdale.	Canaan.	Keeseville.
Peroxyd of manganese,	68·50	50·50	33·40
Peroxyd of iron,	16·75	24·50	34·10
Earthy matter,	3·25	4·50	8·75
Water,	11·50	20·50	24·00

Heated in the matrass it gives off much water. Berzelius considers it a hydrate of manganese. Mixed with linseed oil it undergoes spontaneous combustion.*

OBS. On account of the porous nature of this mineral, it appears to be very light when held in the hand; but on immersing it in water it imbibes water rapidly, and gives the above specific gravity. This species has been found principally in the manganese pits, near Exeter in Devonshire, Cornwall, the Hartz, and Piedmont. It is supposed to be the coloring ingredient of the common dendritic delineations upon limestone, steatite, and other substances.

Earthy manganese is abundant in the counties of Columbia and Dutchess, N. Y., at Austerlitz, Canaan Centre and elsewhere, where it occurs as a marsh deposit, and according to Mather has proceeded from the decomposition of brown spar. There are large deposits of this bog manganese at Blue Hill Bay, Dover, and other places in Maine, and in these regions, it may have been formed by the decomposition of the black oxyd of manganese, which occurs in the vicinity.

The *Groroilite* of Berthier occurs in rounded pieces in sand and clay at Groroi, Cautern, and Vecdessos in France. *Color* brownish-black. *Lustre* dull, submetallic. *Streak* light-chocolate. It dissolves slowly in concentrated sulphuric acid, and colors the acid a fine violet-red. By ignition it loses 24 per cent. of its weight in water and oxygen, without changing its form, but acquires a reddish color.

VARVACITE.

Occurs in thin plates and fibres, often radiating; crystalline form not distinguishable.

H.=2·5—3. G.=4·283—4·623. *Lustre* submetallic. *Streak* black. *Color* steel-gray, iron-black. Opaque.

Composition, according to Mr. R. Phillips, Protoxyd of manganese 81·12, oxygen 13·48, water 5·40.

OBS. It occurs in the county of Warwick, whence the name Varvacite. It has also been observed in the Hartz.

NEWKIRKITE.

Occurs in small needles, under the microscope apparently rectangular prisms.

H.=3—3·5. G.=3·824. *Lustre* metallic splendent. *Color* a brilliant black. Opaque. Rather sectile.

Composition, according to W. Muir, Deutoxyd of manganese 56·30, peroxyd of iron 40·35, water 6·70=103·35.

OBS. It occurs forming a coating on red Hematite, at Newkirchen in Alsace, and was named by Thomson from its locality.

CHROMIC IRON. SIDERUS CHROMIFERUS.

Octahedral Chrome Ore, *M*. Chromate of Iron. Chromiron Ore. Chromeisenstein. Eisenchrom. Fer Chromaté.

Primary form, the regular octahedron. *Secondary form*: fig. 9, Pl. I, from Hoboken, N. J., and Bare Hills, near Baltimore. Occurs usually massive—structure granular—particles strongly coherent.

H=5·5. G.=4·321 of crystals, Thomson; 4·498, a variety from Stiria. *Lustre* submetallic. *Streak* brown. *Color* between iron-black and brownish-black. Opaque. *Fracture* uneven. Brittle.

Composition, according to Klaproth, (Beit. iv, 132,) Thomson, (Min. i, 482,) and Abich, (Pogg. xxiii, 335.)

		Baltimore.	
Green oxyd of chromium,	55·5	52·95	60·04
Protoxyd of iron,	33·0	29·24	20·13
Alumina,	6·0	12·22	11·85
Water, (Loss by heat,)	2·0	0·70	——
Silica,	2·0	trace	——
White substance undetermined,	—	3·09	Magnesia, 7·45
	98·5, Klap.	98·20, Thom.	99·47, Abich.

It is infusible alone before the blowpipe. With borax it fuses with difficulty, but completely, to a beautiful green globule. In small fragments it is attracted by the magnet.

OBS. Chromic iron occurs only in serpentine rocks, forming veins, or in imbedded masses. It assists in giving the variegated color to verd-antique marble.

It occurs in the Gulsen mountains, near Kraubat in Styria; also in the islands of Unst and Fetlar in Shetland; in the Department du Var in France, Silesia, Bohemia, &c.

At Baltimore, Md., in the Bare Hills, it occurs in large quantities in veins or masses in serpentine; also in Montgomery county, six miles north of the Potomac; at Cooptown, Harford Co., and in the north part of Cecil Co., Md. It occurs both massive and in crystals at Hoboken, N. J., imbedded in serpentine and dolomite; also at Milford and West Haven, Conn.; also in large masses in the southwestern part of the town of New Fane, Vt., and Chester and Blanford, Mass.

This ore affords the oxyd of chrome, which, both alone and in combination with the oxyds of other metals, is extensively used in oil-painting, dyeing, and in coloring porcelain.

CROCIDOLITE. SIDERUS FIBROSUS.

Krokidolite, *Hausmann*. Blue Asbestus. Blue Iron Stone, Blaueisenstein, *Klaproth*.

Fibrous—fibres long but very minute and easily separable; also massive.

H.=4. G.=3·2—3·265. *Streak* and *color* lavender-blue or leek-green. Opaque. Fibres somewhat elastic.

Composition. according to Stromeyer and Hausmann, (Pogg. xxiii, 156,)

Silica,	50·81	51·64
Protoxyd of iron,	33·88	34·38
Peroxyd of manganese,	0·17	0·02
Magnesia,	2·32	2·64
Lime,	0·02	0·05
Soda,	7·03	7·11
Water,	5·58=99·81	4·01=99·85

When heated to redness, it melts easily to a black shining, opaque, and somewhat frothy glass, which is attractable by the magnet. The single fibres readily fuse in the flame of a spirit lamp. With borax it forms a green transparent bead, which, by adding saltpetre, is changed to brown.

OBS. It occurs in Africa, in the Grigna country, beyond the Great Orange river, seven hundred miles up from the Cape of Good Hope. Stavern in Norway is stated as another locality; but the mineral it affords does not precisely resemble the African variety.

The name of this species is derived from κροκις, *woof*, in allusion to its wool-like fibrous structure.

ANTHOSIDERITE. Siderus plumosus.

Hausmann, Gött. gel. Anz. 1841, p. 281. Pogg. lii, 292, 1841.

In tufts of a fibrous structure, and sometimes collected into feathery flowers.

H.=6·5. G. about 3. *Color* ochre-brown, somewhat grayish. Opaque, or slightly subtranslucent. Gives sparks with a steel. Tough.

Composition, according to Schnedermann, Silica 60·08, peroxyd of iron 34·99, water 3·59=98·66.

OBS. This mineral comes from the province *Minas Geraes*, in Brazil, where it is associated with magnetic iron. The name anthosiderite is derived from ανθος, *flower*, and σιδηρος, *iron*, and alludes to its imitative crystallizations.

HISINGERITE. Siderus Hisingeri.

Hisingerit, *Berz.* Thraulite, *Kobell.* Hydrous sesquisilicate of iron.

Imperfectly crystallized. *Cleavage* distinct in one direction. Soft. G.=3·045. *Streak* greenish-gray or brownish-yellow. *Color* black. Opaque. Cross fracture earthy. Sectile.

Composition, according to Berzelius, Hisinger, (Pogg. xiii, 505,) and Kobell, (Pogg. xiv, 467,)

		Ridderhyttan.	Bodenmais.
Oxyd of iron,	51·50	49·869	50·86
Silica,	27·50	31·775	31·28
Alumina,	5·50	——	——
Oxyd of manganese,	0·77	——	——
Water,	11·75	20·000	19·12
Magnesia,	trace=97·02, B.	——=101·644, H.	——=101·26, K.

Heated in a glass tube it gives out water. Before the blowpipe it becomes magnetic, and at a high temperature melts to a dull opaque black globule; with borax it forms a yellowish-green glass.

OBS. Hisingerite occurs in the cavities of calcareous spar, in the parish of Svärta, in Södermanland, Sweden; also at Bodenmais in Germany. It was first described and analyzed by Hisinger.

CRONSTEDTITE. Siderus foliaceus.

Rhombohedral Melane-mica, *M.* Cronstedtite, *Steinmann.* Hydrous silicate of iron, *Thom.* Chloromelan.

Primary form, a rhombohedron. Occurs in hexagonal prisms, tapering towards their summit, or adhering laterally; also in diverging groups, reniform, and amorphous. *Cleavage* highly perfect, parallel to a, or the base of the prism.

H.=2·5. G.=3·348. *Lustre* brilliantly vitreous. *Streak* dark leek-green. *Color* brownish-black. Opaque. Not brittle. Thin laminæ elastic.

Composition, according to Steinmann, (Schweigger's Jahrbuch, ii, 69,)

		Var. Cronstedtite.
Silica,	22·452	22·83
Protoxyd of iron,	58·853	57·61
Water,	10·700	10·70
Protoxyd of manganèse,	2·885	3·82
Magnesia,	5·078=99·968, S.	3·25=98·21, S.

Before the blowpipe it froths a little, but does not melt. With borax it affords a hard black opaque bead. When in the state of powder, it gelatinizes in concentrated muriatic acid.

Obs. It accompanies hydrate of iron and calc spar, in veins containing silver ores, at Przibram in Bohemia. It occurs also at Wheal Maudlin in Cornwall, in diverging groups; also with quartz and magnetic pyrites, at the mines of Conghonas do Campo in Brazil.

CHLOROPAL.

Bernhardi and *Brandes*, Schweigger's J. xxxv, 29.

Massive; structure impalpably granular; earthy.

H.=3—4. G.=1·727—1·870; earthy varieties, the second a conchoidal specimen; 2·105, Thomson, a Ceylon chloropal. *Color* greenish-yellow and pistachio-green. Opaque—subtransparent. Fragile. *Fracture* conchoidal and splintery.

Composition, according to Bernhardi and Brandes, and Thomson, (Min. i, 464,)

	Hungary.	Hungary.	Ceylon,
Silica,	46	45·00	53·00
Peroxyd of iron,	33	32·00	26·04
Magnesia,	2	2·00	1·40
Alumina,	1	0·75	1·80
Water,	18=100, B. & B.	20·00=99·75, B. & B.	18·00=100·24, T.

Infusible before the blowpipe, but blackened and rendered opaque. With carbonate of soda it forms a clear glass, exhibiting some red points. With borax it fuses to a clear glass, having no red points.

Obs. The mineral analyzed by Thomson, differs essentially from the specimens from Hungary. The latter are described as breaking readily into a kind of parallelopiped, the upper end and two adjoining lateral edges of which, have the opposite magnetic pole from the lower end and the other two edges. The Ceylon variety appeared to Thomson to be destitute of this peculiarity.

SIDEROSCHISOLITE.

Wernekink, Pogg. i, 387. Chamoisite; *Berthier*, Ann. des Mines, v. 393. Hydrous disilicate of iron *Thomson*.

In very minute crystals; also massive.

H.=2—3. G.=3—3·4. *Lustre* splendent; sometimes earthy,

when massive. *Streak* leek-green, greenish-gray. *Color* pure velvet-black when crystallized; dark greenish-gray. Opaque.

Composition, of the crystallized and massive varieties, according to Wernekink and Berthier,

	Sideroschisolite.	Chamoisite.
Silica,	16·3	12·0
Protoxyd of iron,	75·5	50·5
Alumina,	4·1	6·6
Water,	7·3	14·7
Carbonate of lime,	——	14·4
Carbonate of magnesia,	——=103·2, W.	1·2=99·4, B.

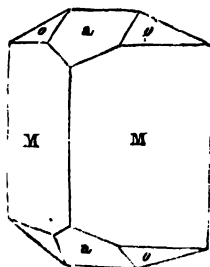
These varieties are therefore each a *hydrous disilicate of iron*, and differ only in the proportion of water. Heated, it at first becomes black and magnetic; afterwards it changes to an ochre-red. In a glass tube water is evolved. It forms a jelly with muriatic acid. The massive variety, chamoisite, effervesces with acids, on account of the carbonate of lime with which it is mixed. The solution obtained with the crystalline variety, sideroschisolite, is greenish-yellow.

Obs. Crystallized specimens occur in cavities of magnetic pyrites and sparry iron ore, in small crystals, at Conghonas do Campo in Brazil. Chamoisite occurs in beds of small extent, in a limestone mountain, abounding in ammonites, at Chamoisin in the Valais.

YENITE. Siderus rhombicus.

Di-Prismatic Melane-ore, *M.* Yenite, Ilvait, *Haus.* Lievrite, Fer Calcareo Siliceux, *H.*

Primary form, a right rhombic prism; M : M=112° 37′. *Secondary form:* a : o=158° 49′, o : o=139° 37′, and 117° 38′, M : o=128° 38′. Lateral faces usually striated longitudinally. *Cleavage* parallel to the longer diagonal, indistinct. Also massive, columnar and granular. When the latter, the structure is often nearly impalpable.



Elba.

H.=5·5—6. G.=3·8—4·1; 3·994, Haidinger; 3·9796, Stromeyer; 3·825—4·061, Lelievre. *Lustre* submetallic. *Streak* black, inclining to green or brown. *Color* iron-black, or dark grayish-black. Opaque. *Fracture* uneven. Brittle.

Composition, according to Vauquelin (Jour. des Mines, xxi, 70) and Stromeyer, (Untersuchungen, p. 374,)

	Elba.		Elba.
Silica,	29		29·278
Lime,	12		13·779
Peroxyd of iron,	57	Protoxyd,	52·542
Peroxyd of manganese,			1·587
Alumina,	—		0·614
Water,	—=98, Vauq.		1·268=99·068, Strom.

Rammelsberg finds that the oxyd of iron is in part peroxyd, and obtained, in an analysis agreeing nearly with Stromeyer's, Protoxyd of iron 33·074, and peroxyd 22·800, (Pogg. l, 157, 1840.)

Before the blowpipe, on charcoal, it fuses to a black globule, which becomes vitreous in the external flame. In the interior flame the surface becomes dull, and provided the globule has not been heated to redness, it is attractable by the magnet. With borax and carbonate of soda, it fuses to a glass, nearly or perfectly black. It is soluble in muriatic acid.

OBS. This mineral was first discovered on the Rio la Marina, in Elba, by M. Lelievre, in 1802, where it occurs in solitary crystals of considerable dimensions, and aggregated crystallizations in compact augite. It has also been observed at Fassan, in Norway, in Siberia, and Silesia.

At Cumberland, R. I., it occurs in long slender black or brownish-black crystals, traversing quartz, and associated with magnetic iron ore and hornblende; also in Essex Co., N. Y.

The name *Lievrite* was given this mineral in honor of its discoverer. *Ilvaite* is derived from the name of the island (Elba) on which it was found. *Yenite*, or Jenite, was applied by the French in commemoration of the battle of Jena, in 1806.

WEHRLITE.

Massive, granular.

H.=6—6·5. G.=3·90. *Lustre* submetallic. *Color* iron-black. *Streak* greenish, and powder greenish-gray. Magnetic.

Composition, according to Wehrle, Silica 34·60, peroxyd of iron 42·38, protoxyd of iron 15·78, lime 5·84, peroxyd of manganese 0·28, alumina 0·12, water 1·00=100.

Fuses with difficulty on the edges before the blowpipe. Only imperfectly dissolved in muriatic acid.

OBS. Wehrlite was described by Zipser and Wehrle, as a variety of Lievrite. Kobell distinguished it as a species, and gave it the name it bears, in honor of Wehrle. It is still doubtful whether it is distinct. It occurs at Szurraskò, in the Zemescher district, Hungary.

BROWN IRON ORE. SIDERUS HÆMATICUS.

Prismatic Iron Ore, *M.* and *J.* Brown Hematite. Brown Iron Ore. Hydrous Peroxyd of Iron. Limonite, *Beud.* Brown Ochre. Iron Stone. Bog Iron Ore. Yellow Clay Iron Stone. Brauneisenstein, Thoneisenstein, *W.* Gelberde. Eisen oxyd-hydrat, *L.* Fer Oxydé, *H.* Fer Hydro-Oxidé, *Levy.*

Usually in stalactitic and botryoidal or mammillary forms, having a fibrous structure; also massive, and occasionally earthy.

H.=5—5·5. G.=3·6—4. *Lustre* silky, often submetallic; sometimes dull and earthy. *Streak* yellowish-brown. *Color* various shades of brown, commonly dark, and none bright.

Brown iron ore consists of peroxyd of iron 85·3, and water 14·7, with occasional impurities. A very pure stalactitic specimen from Amenia, N. Y., gave Beck (Min. N. Y. p. 33) Peroxyd of iron 82·90, silica and alumina 3·60, water 13·50, with a trace of oxyd of manganese.

Before the blowpipe it blackens and becomes magnetic; with borax it fuses to a green or yellow glass. It dissolves in warm nitro-muriatic acid, and gives out water when heated in a matrass.

OBS. The following are the principal varieties of this species. *Brown hematite* includes the ordinary imitative shapes. *Scaly* and *ochrey brown iron ore* are more or less decomposed earthy varieties, often soft like chalk; yellow ochre is here included. *Bog iron ore* is a brittle or loosely aggregated submetallic ore, occurring in low marshy grounds. It proceeds from the decomposition of other species, and often takes the form of the leaves, nuts or stems found in the marshy soil. The pisiform and reniform clay iron ores consist of concentric globular concretions, imbedded either in friable or compact brown hematite.

Brown iron ore occurs both in primitive and secondary rocks, in beds and veins, associated at times with spathic iron, heavy spar, calcareous spar, Arragonite, and quartz; and it is often associated with ores of manganese, especially when in veins.

Brown iron ore occurs at Cornwall, Clifton, Sandloge in Shetland, in Carinthia and Bohemia, at Siegen near Bonn, and at Villa Rica in Brazil. The bog ore forms large beds in Germany, Poland, and Russia.

This ore of iron is very abundant in the United States. We mention here a few only of its localities, and would refer to the various geological reports for more complete lists. Extensive beds of brown iron ore, accompanied by the ochrey iron ore, exist at Salisbury and Kent, Conn., in mica slate; also in the neighboring towns of Beekman, Fishkill, Dover, and Amenia, N. Y., and in a similar situation north at Richmond and Lenox, Mass. At Hinsdale it is the cement in a conglomerate quartz rock. It is very abundant at Ben-

nington, Vt., also at Monkton, Pittsford, Putney, and Ripton, of the same State. Nantucket and Martha's Vineyard are other localities; also near Tinder's Gold Mine, Louisa Co., Va., there is an abundant deposit. The argillaceous varieties are abundant in Pennsylvania, near Easton, and through the Lehigh range in Fayette Co., at Armstrong, Upper Dublin, and in Washington Co. In nodules, from one inch to a foot in diameter, it is met with at Bladensburg, Md.; also in gravel hills, near Marietta in Ohio. An argillaceous ore is also found on Mount Alto, in the Blue Ridge, in Shenandoah Co., Va., and in Chatham and Nash Co., N. C.

Brown iron ore is one of the most important ores of iron. The pig iron, from the purer varieties obtained by smelting with charcoal, is readily convertible into steel. That yielded by bog ore is what is termed *cold short*, and cannot therefore be employed in the manufacture of wire, or even of sheet iron, but is valuable for casting. The hard and compact nodular varieties are employed in polishing metallic buttons, &c.

GÖTHITE. Siderus rutilus.

Prismatoidal Habroneme Ore, *M.* Onegite. Pyrosiderite. Rubinglimmer. Stilpnosiderite. Pecheisenerz. Nadeleisenerz. Lepidokrokite.

Primary form, a right rhombic prism; M : M=130° 14′. *Cleavage* parallel with the shorter diagonal.

H.=5. G.=4·0—4·2; 4·04, crystals from St. Just. *Lustre* imperfect adamantine. *Color* brown. Often subtransparent and blood-red by transmitted light. *Streak* brownish-yellow—ochre-yellow.

Composition, according to Kobell (J. d'Erdmann, 1834, p. 181) and Thomson, (Min. i, 439,)

	Lepidokrokite, Oberkirchen.	*Göthite,* Eiserfeld.	*Lepidokrokite,* Hollerter Zug.	*Göthite.*
Peroxyd of iron,	90·53	86·35	85·65	91·7
Water,	9·47	11·38	11·50	8·5
Silica,	trace	0·85	0·35	——
Peroxyd of mang.	——	0·51	2·50	——
Oxyd of copper,		0·90	——	——
	100·00, K.	99·99, K.	100·00, K.	100·2, T.

This species contains half as much water as the preceding. Kobell considers the stilpnosiderite a massive variety of it; it consists, according to him, of Peroxyd of iron 82·87, water 13·46, silica 0·67, phosphoric acid 3·00=100·00. Before the blowpipe the varieties act like brown iron ore.

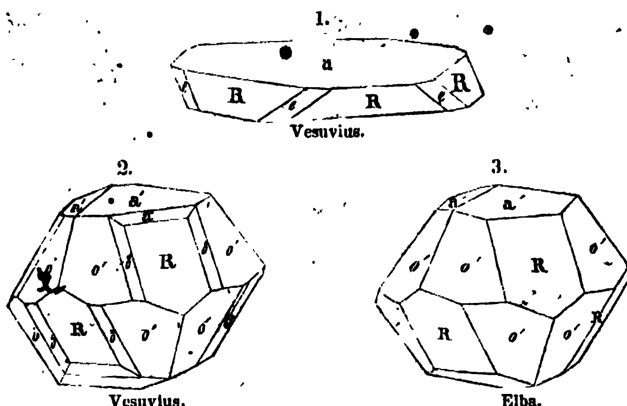
Obs. The Lepidokrokite of Oberkirchen occurs in prismatic radiating crystals, imbedded in fibrous red oxyd of iron, in quartz, and in nodules of chalcedony. The Göthite of Eiserfeld, in the county of Nassau, occurs in foliated crystallizations, of a hyacinth-red color, with brown hematite. The Lepidokrokite of Hollerter Zug occurs in rounded masses, of a fibrous or lamellar structure. Stilpnosiderite, pitchy iron ore, or pecheisenerz, is found at Siegen. Other localities of crystallized specimens are at Clifton, near Bristol, near Lostwithrel in Cornwall, and at Lake Onega in Siberia.

SPECULAR IRON. Siderus rhombohedrus.

Rhombohedral Iron Ore, *M.* Rhomboidal Iron Ore, *J.* Red Iron Ore. Oligiste Iron. Micaceous Iron Ore. Red Hematite. Red Clay Ironstone. Red Ochre. Iron Foam. Peroxyd of Iron. Eisen Glanz. Rotheisenstein, *W.* Blutstein, *Haus.* Rotheisenerz. Eisenoxyd, *L.* Fer Oligiste, *H.*

Primary form, an acute rhombohedron; R : R=85° 58′, and 94° 2′. *Secondary forms:* R : e=137° 1′, o′ : o′=128° and 122° 29′, R : [illegible]=151° 14′, a′ : a′=142° 56′. *Cleavage* parallel to a and R, often indistinct. *Compound crystals:* composition of the

first kind or parallel to R; also of the third kind, in which it takes place parallel to a, the truncating plane of the vertical angle. *Imperfect crystallizations:* structure columnar—globular, reniform,



Vesuvius.

Vesuvius. Elba.

botryoidal, and stalactitic shapes, and also amorphous; structure lamellar—laminæ joined parallel to a, and variously bent—thick or thin; structure granular—particles often nearly impalpable—slightly or strongly coherent. Pseudomorphs, imitative of calcareous spar, fluor spar, &c.

H.=5·5—6·5. G.=4·5—5·3; of some compact varieties, as low as 4·2. *Lustre* metallic and occasionally splendent—massive varieties sometimes earthy. *Streak* cherry-red or reddish-brown. *Color* dark steel-gray or iron-black; impure varieties, red and unmetallic. Opaque, except when in very thin laminæ, which are faintly translucent and of a blood-red tinge. *Fracture* sub-conchoidal, uneven. Sometimes it is slightly attractable by the magnet; the volcanic varieties occasionally exhibit polarity.

Composition, when pure, Iron 69·34, oxygen 30·60. D'Aubuisson found red hematite to contain peroxyd of iron 94, silica 2·0, lime 1·0, water 3. Dr. Henry found in iron froth, peroxyd of iron 94·5, silica ? 4·25, alumina 1·25.

Infusible, alone, before the blowpipe; with borax it forms a green or yellow glass. Dissolves in heated muriatic acid.

Obs. This species includes the old species specular iron and red iron ore, which are identical in chemical composition, and differ only in the state of aggregation of the particles. *Specular iron* includes specimens of a perfect metallic lustre; if the structure is micaceous, it is called *micaceous iron.* The varieties of a sub-metallic or non-metallic lustre, were included under the name of *red hematite, fibrous red iron;* or if soft and earthy, *red ochre,* and when consisting of slightly coherent scales, *scaly red iron,* or *red iron froth.* Under this species must also be included the different clay or argillaceous iron ores, many of which contain but small portions of iron; *reddle* or *red chalk,* the common drawing material, which has an earthy appearance and a flat conchoidal fracture; *jaspery clay iron,* more firm in its structure than the preceding, and having a large and flat conchoidal fracture; *columnar* and *lenticular argillaceous iron,* distinguished by a columnar or flat granular structure.

Specular iron occurs commonly in primitive rocks; it also occurs among the ejected lavas of Vesuvius. The argillaceous ores form beds in secondary rocks.

The most magnificent specimens of this species are brought from the island of Elba, which has afforded it from a very remote period, and is described by Ovid as the " Insula inexhaustis chalybdum generosa metallis." The surfaces of the crystals often present a splendid irised tarnish, and, connected with a brilliant lustre, they are among the most striking objects in the cabinet of the mineralogist. The faces a and a′ are usually destitute of this tarnish and lustre, and may therefore assist, when present, in determining the situation of other planes when the crystal is quite complex. St. Gothard affords very beautiful specimens, composed of crystallized plates grouped together in the form of rosettes, and accompanying crystals of feldspar. Fine crystallizations are the result of volcanic action at Etna and Vesuvius, and particularly in Fossa Kankarone, on Monte Somma, where it forms crystalline incrustations on the ejected lavas. Arendal in Norway, Langbanshyttan in Sweden, Framont in Lorraine, Dauphiny, and Switzerland, also afford splendid specimens of specular iron. Red hematite occurs in reniform masses of a fibrous concentric structure, near Ulverstone in Lancashire, in Saxony, Bohemia, and the Hartz. In Westphalia, it occurs as pseudomorphs of calcareous spar. Iron-mica comes principally from Cattas Atlas in the Brazils.

Specular iron, both compact, micaceous, and jaspery, is abundant in St. Lawrence and Jefferson Co., N. Y., at Gouverneur, Hermon, Edwards, Fowler, Canton, &c. Handsome irised crystallizations of specular iron are found at Fowler, in cavities in granular micaceous iron ore, and associated often with splendid groups of quartz crystals. Other localities are Woodstock and Aroostook, Me., and Liberty, Md. It occurs also in the Blue Ridge, in the western part of Orange Co., Va. Micaceous iron, in large masses, composed of irregular curved laminæ, occurs at Hawley, Mass. and Piermont, N. H.; also eight miles above Falmouth, Stafford Co., Va., on the Rappahannock river. Red hematite is found at Ticonderoga, upon Lake George. The two iron mountains of Missouri are situated about fourteen miles from the La Motte lead mines, and ninety miles south of St. Louis. They are conical hills, consisting of iron ore, " in masses of all sizes, from a pigeon's egg to a middle size church," affording inexhaustible supplies for our western country, (Prof. Hall.) The ore is both massive and the micaceous variety, with vast quantities of the red ochreous iron, about the one called the Pilot Knob. Lenticular argillaceous ore is abundant in Oneida, Herkimer, Madison, and Wayne Counties, N. Y., constituting one or two beds, 12 to 20 inches thick, in a compact sandstone.

This ore affords a considerable portion of the iron manufactured in different countries. These varieties, especially the specular, require a greater degree of heat to smelt than other ores, but the iron obtained is of good quality. Pulverized red hematite is employed in polishing metals, and also as a coloring material. Specular iron is readily distinguished from magnetic iron ore, by its reddish streak.

Hematite, a word in use among the ancients, was applied to this and the preceding species on account of the red color of the powder, from αἷμα, *blood*. The term *specular* alludes to the brilliant lustre it often presents.

MAGNETIC IRON ORE. Siderus octahedrus.

Octahedral Iron-Ore, *M.* Oxydulated Iron. Ferroso-ferric Oxyd. Magneteisenstein *of the Germans*. Fer Oxidulé, *H.*

Primary form, the regular octahedron. *Secondary forms*: most of the forms represented in the first twenty figures of Pl. I; also fig. 25, Pl. I. Figure 3 has been observed at O'Niel mine, Orange Co., N. Y. A crystal resembling figure 16 has been described by Breithaupt, having the angle B, 168° 39′, and C, 101° 53′. *Cleavage* parallel to the primary form; perfect—imperfect. The dodecahedral faces are commonly striated parallel to the longer diagonal. *Compound crystals*: fig. 129, Pl. II; also the same kind of composition with the secondary modifications. *Imperfect crystallizations*: structure granular—particles of various sizes, sometimes impalpable.

H.=5.5—6.5. G.=5.094. *Lustre* metallic—submetallic. *Streak* black. *Color* iron-black. Opaque. *Fracture* subconchoidal, shi-

ning. Brittle. Strongly attracted by the magnet, and sometimes possessing polarity.

Composition, Peroxyd of iron 69, protoxyd of iron 31. Before the blowpipe it becomes brown, and loses its influence on the magnet, but does not fuse. With borax, in the oxydizing flame, it fuses to a dull-red glass, which becomes clear on cooling, and often assumes a yellow tint; in the reducing flame it becomes bottle-green. Dissolves in heated muriatic acid, but not in nitric acid.

Obs. Magnetic iron ore occurs in beds in primitive rocks, generally in gneiss or syenite, also in beds and isolated crystals in clay slate, hornblende slate, chlorite slate, greenstone, and occasionally in limestone.

The beds of ore at Arendal and nearly all the celebrated iron mines of Sweden, consist of massive magnetic iron. Dannemora, and the Täberg in Småland, are entirely formed of it. Still larger mountains of it exist at Kurunavara and Gelivara, in Lapland. Fahlun in Sweden, and Corsica, afford octahedral crystals, imbedded in chlorite slate. Splendid dodecahedral crystals occur at Normark in Wermeland. The most powerful native magnets are found in Siberia, and in the Hartz. They are also obtained on the island of Elba.

Very extensive beds of magnetic iron occur in the counties of Warren, Essex, and Clinton, New York, in granite, syenite, syenitic granite, or allied rocks; and in Orange, Putnam, Saratoga, Herkimer counties, &c., in gneissoid granite, either in isolated masses or layers alternating with the layers of gneiss, (Beck;) also in the mountainous districts of New Jersey and Pennsylvania, and on the eastern side of Willis mountain in Buckingham Co., Virginia. Dodecahedral crystals occur at Franconia, N. H., in epidote and quartz, and at Warwick, N. Y. Octahedrons occur at Marlboro' and Bridgewater, Vt., in chlorite or chlorite slate; at Swanzey, near Keene, and Unity, New Hampshire; at Deer Creek, Md.; at O'Neil mine, Orange Co., N. Y., along with the forms represented in figures 2 and 3, Plate I. At Haddam, Conn., it presents the forms in figures 8 and 9, Plate I: occurs also at Hamburgh, near the Franklin furnace, N. J., and at Raymond, Davis's Hill, Maine, in an epidotic rock. Masses strongly magnetic occur at Marshall's Island, Me. Octahedral and dodecahedral crystals are abundant at Morgantown, Berk's Co., Pennsylvania.

No ore of iron is more generally diffused than the magnetic, and none superior for the manufacture of iron. It is easily distinguished by its being attracted readily by the magnet, and also by means of the black color of its streak or powder, which is some shade of red or brown in specular iron and brown iron ore. The ore when pulverized may be separated from earthy impurities by means of a magnet, and machines are in use in many parts of Northern New York for cleaning the ore on a large scale.

FRANKLINITE. SIDERUS ZINCIFERUS.

Dodecahedral Iron Ore, *M.*

Primary form, the regular octahedron. *Secondary forms*: fig. 9, and others, Pl. I. *Cleavage* octahedral, indistinct. Also massive, coarse or fine granular—particles strongly coherent.

H.=5·5—6·5. G.=5·069, Thomson; 5·091, Haidinger; 4·87, Berthier. *Lustre* metallic. *Streak* dark reddish-brown. *Color* iron-black. Opaque. *Fracture* conchoidal. Brittle. Acts slightly on the magnet.

Composition, according to Berthier, (Ann. des M. iv, 489, 1819,) and Thomson, (Min. i, 438,)

Peroxyd of iron,	66	66·100
Sesquoxyd of manganese,	16	14·960
Oxyd of zinc,	17	17·425
Silica,	—	0·204
Water,	—=99, B.	0·560=99·249, T.

ure, zinc is driven off. Dissolves without effervescence in hot muriatic

OBS. Franklinite is stated to occur in amorphous masses at the mines of Altenberg, near Aix la Chapelle.

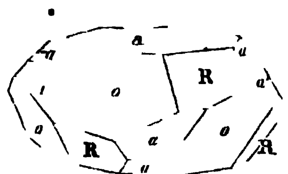
It is abundant at Hamburgh, N. J., near the Franklin furnace, where it is accompanied by red oxyd of zinc and garnet in calcareous spar. The most perfect crystals are imbedded in red zinc ore; those occurring in calc spar have their angles rounded. A still more remarkable deposit exists at Sterling, in the same region, where it is associated with Troostite in a large vein, in which cavities occasionally contain crystals from one to four inches in diameter.

The attempts to work this ore for zinc have proved unsuccessful.

ILMENITE. SIDERUS ACROTOMUS.

Axotomous Iron ore, *M.* Titanate of Iron. Crichtonite, *Bournon.* Titaniferous Iron. Iserine. Ilmenite, *G. Rose.* Menakan. Menaccanite. Kibdelophan. B. mund in *Kobell.* Titaneisensand. Hystatite. Titanisches Eisenerz, *Breit.* Washingtonite, *Shepard.* Mohsite.

Primary form, an acute rhombohedron; R : R=85° 59′. *Secondary*, the annexed figure; a1 * an acute rhombohedron of 61° 29′. *Cleavage* parallel with the terminal plane a—perhaps only a surface of composition. Crystals usually tabular. *Imperfect crystallizations*: thin plates or laminæ, angular masses and grains.



H=5—6. G.=4.5—5. *Lustre* submetallic. *Streak* metallic. *Color* iron-black. Opaque. *Fracture* conchoidal. Influences slightly the magnetic needle.

Before the blowpipe, alone unchanged. With salt of phosphorus in the reduction flame, gives a dull red glass.

This species includes several varieties which have been considered distinct species. They are however identical in crystallization and the differences arise from the isomorphous nature of titanate of iron and peroxyd of iron. The following are the most important of the varieties.

Axotomous iron. Physical characters as above. H=5—5.5. G.=4.661, Mohs; 4.723—4.8?, Breit. Occurs in crystals, usually massive, or in thin plates or laminæ. According to Kobell's analysis (Min. 1838, p. 317) it consists of titanic acid 59.00, protox. iron 36.00, perox. iron 4.25, prot. manganese 1.65. This is Kobell's *Kibdelophan.*

Crichtonite. This variety occurs at Oisans in acute rhombohedrons, R : R=61° 29′.* H=6. G.= . Cleavage imperfect. It has not been analyzed.

Ilmenite. Occurs crystallized and massive at Ilmensee, near Miask, whence the name *Ilmenite.* In general the physical characters the same as above. H=6. G.=4.805, Breit. R : R=85° 43′. *Cleavage* rhombohedral, indistinct. *Fracture* conchoidal—uneven. According to Mosander, it consists of

Titanic acid 46.92, prot. iron 37.86, perox. iron 10.74, prot. manganese 2.73, magnesia 1.14=99.39.

Washingtonite, Shepard, Silliman's J. xliii, 364. Near Ilmenite in crystallographic and physical characters, yet remarkable for the size and form of its large tabular crystals, which are sometimes two inches in diameter. They are hexagonal or rhombohedral tables, or the former with faces of the rhombohedron. R : R=86°, (obtained by varnishing the faces.) Rhombohedral cleavage often distinct, sometimes an indistinct cleavage parallel with a. a is the brightest face, R the least so. H=5.75. G.=4.963 (from Westerly,) 5.016 (from Litchfield.)

Menaccanite. Occurs massive with traces of cleavage. *Fracture* uneven to flat conchoidal. H=5.5. G.=4.7—4.8. *Streak* black. *Color* light iron-black to steel-gray. Magnetic. According to Kobell, it consists of

* This is the rhombohedron, 5 R.

Titanic acid 43·24, prot. iron 27·91, perox. iron 28·66=99·81.

This mineral was first observed near Menaccan, Cornwall. The specimen analyzed by Kobell was from Egersund, Norway, where it occurs massive and compact.

Hystatite. Hystatisches Eisenerz, Breit. *Titaniferous iron from Arendal.* R : R=86° 10′. Cleavage, color, &c., as above. H.=6. G.=5. Magnetic. According to Mosander, it consists of

Titanic acid 24·19, prot. iron 19·91, perox. iron 53·01, lime and magnesia 1·01, silica 1·17=99·29.

This variety comes from Tvedestrand, near Arendal.

Eisenrose, Basanomelan, (Kobell,) is placed by Breithaupt along with hystatite; but Kobell finds it to consist of

Titanic acid 12·67, prot. iron 4·84, perox. iron 82·49.

iron-black. *Streak* black. *Fracture* conchoidal. Strongly magnetic.
of the analyses by Cordier and Klaproth gives,

Titanic acid 15, perox. and prot. iron 85.

Kobell remarks that it is doubtful whether the crystallized grains were not magnetic iron.

The *titaniferous iron* of Aschaffenburg, according to Kobell's analysis, consists of Titanic acid 14·16, prot. iron 10·04, perox. iron 75·00, prot. manganese 0·80. Occurs massive and in plates, with imperfect cleavage in one direction. H.=6. G.=4·78. *Color* iron-black.

Iserine is physically similar to the last. According to Klaproth, it consists of Titanic acid 27·8, perox. and prot. iron 72·2. The name is derived from the river Iser in Bohemia.

Obs. Fine crystals, sometimes an inch in diameter, occur in Warwick, Amity, and Monroe, Orange Co., N. Y., imbedded in serpentine and white limestone and associated with spinel, chondrodite, rutile, &c.; also four miles west of Edenville, and near Greenwood furnace with spinel and chondrodite; also at South Royalston, Mass.

The Washingtonite of Shepard occurs at Washington and Litchfield, Conn., in a quartz vein in mica slate, and at South Britain in rolled masses of quartz; also at Westerly, R. I., and at Goshen, Mass., in thin folia with spodumene.

WARWICKITE.

Shepard, Silliman's Jour. xxxiv, 313, and xxxvi, 85.

Primary form, an oblique rhombic prism; M : M=93°—94°, Shepard; 102°—105°, Beck. *Secondary form:* the primary with the obtuse lateral edges truncated, and its acute edges beveled; the summits are generally rounded. *Cleavage*, parallel with the longer diagonal, perfect. Cleavage surfaces finely striated vertically, and exhibiting distinct oblique cross cleavages.

H.=5·5—6. G.=3—3·29. *Lustre* metallic-pearly on the cleavage surface; of other surfaces, vitreous or subvitreous: often nearly dull. *Color* dark hair-brown to iron-gray, and often with a copper-red tinge on the face of perfect cleavage. Decomposing crystals are nearly iron-black, with a faint tinge of purple. *Fracture* uneven. Brittle.

Composition, according to Shepard, Titanium 64·71, iron 7·14, yttrium 0·80, fluorine 27·33, with a trace of aluminum.

Does not fuse alone before the blowpipe, but the color becomes lighter. With borax it fuses with effervescence to a glass, which is yellow and nearly opaque while hot, and becomes pale green and clear on cooling. Emits fluoric acid in a glass tube, which corrodes the glass, especially if a little sulphuric acid be added.

Obs. This species was considered a variety of hypersthene, on account of the red tinge of the cleavage plane, till distinguished by Prof. Shepard. It occurs in limestone two and a half miles southwest of Edenville, N. Y., where it is associa-

spinel, chondrodite, serpentine, &c. The crystals are usually small and slender; but occasionally they are met with two inches or more in length and a third of an inch in diameter. The large crystals have a less distinct cleavage than the small ones, and little or no lustre.

IRITE.

Hermann, J. f. prakt Chem xvii, 246 Jahresb. xvii, 191.

In grains or scales. *Structure* thin foliated. *Color* black. *Lustre* shining. G.= 6·506. *Composition:* Sesquoxyd of iridium 62·86, protoxyd of osmium 10·30, protoxyd of iron 12·50, protoxyd of chromium 13·70=99·36.

Occurs in the Ural with native platina, titanic iron, iridosmine, and hyacinth.

ORDER VIII. METALLINEA

IRON FERRUM OCTAHEDRUM

Octahedral Iron *M* and *J* Meteoric Iron Gediegen Eisen *W* and *L* Fer Natif *H* Mars *Alchem*

Primary form, the regular octahedron *Cleavage* octahedral, apparent

H=4·5. G=7·3—7·8, 7·318, a partially oxydized fragment of a crystal of meteoric iron from Guilford Co, N C *Lustre* metallic. *Color* iron gray *Streak* shining *Fracture* hackly Ductile. Acts strongly on the magnet

OBS Native iron, undoubtedly of terrestrial origin, has been observed at Canaan, Conn (Silliman's Am Jour vol xii, p 154) where it occurred in the form of a vein or plate, two inches thick, attached to a mass of mica slate rock It contains graphite between the broad laminæ into which it is divided, and it has no obvious crystalline structure nor is any developed by etching with nitric acid, as in most meteoric irons The specimen from Penn Yan, N Y, has been described by T G Clemson, who states that it contained a minute portion of carbon, but no *nickel* or cobalt An octahedral crystal weighing about 7 ounces from Guilford Co, N C, was found by Prof D Olmsted of Yale College It was reported to have been detached from a mass weighing 28 pounds which a blacksmith worked into nails It was supposed to be terrestrial native iron, but the analysis of Shepard (Silliman's Am Journal, vol xl p 369) proved it to consist of Iron 92·750, nickel 3·115, magnetic iron 0·7 0 and places its meteoric origin beyond a doubt The mass of iron found at Burlington, Otsego Co, N Y, about 1816, is also undoubtedly of meteoric origin

Foreign specimens are also reported to have been found Cramer describes one weighing four pounds tained in the mine of Hackenburg Other Saxon localities are Steinbach and Eibestock

Meteoric iron usually contains nickel, and small quantities of other metals Dr Charles T Jackson first pointed out the existence of chlorine as a constituent in some meteoric iron (See Silliman's Am Journal, vol xxxiv, p 335)

The following analyses of meteoric iron are by Berzelius, (K V Acad H 1834, pp 137, 163, and 171)

	From Blansko.	From Siberia		From Elbogen
Iron,	93·816	88·042		88·231
Nickel,	5·053	10·732		8·517
Cobalt,	0·347	0·455		0·762
Manganese,	——	0·132	Sulphur and mang	trace
Tin and copper,	0·460	0·066		——
Sulphur,	0·324	trace		——
Phosphorus,	trace	——	Metallic phosphurets,	2·211
Magnesium,	——	0·050		0·279
Carbon,	——	0·043		——
Insoluble part,	——=100	0·480=100		——=100

The *first* specimen fell near Blansko, on the 25th November, 1833 The metallic iron constituted only 17·15 part of it The *second* was discovered by Pallas on a mountain, between Krasnojarsk and Abekansk, in Siberia. It contained imbedded olivine The *third* species is supposed to have fallen near the close of the fourteenth century; it is preserved at Vienna.

One of the most extraordinary of these iron meteorites, preserved in any collection, is now in the Yale College cabinet. It weighs 1635 lbs, length three feet four inches;

breadth two feet four inches; height one foot four inches. It has been analyzed by C. U. Shepard, (Silliman's Amer. Jour. xvi, 217,) also by B. Silliman Jr., and found to contain Iron 90·02 to 92·912, nickel 8·80 to 9·674. The crystalline structure of this iron is very remarkable as developed by nitric acid on a polished surface. Mr. Silliman has remarked that the nickel is segregated along the lines of crystallization, and that it is not uniformly alloyed with the iron, as has previously been supposed; (communicated to the author.) It was brought from Red river. Still more remarkable masses exist in South America; one was discovered by Don Rubin de Celis, in the district of Chaco-Gualamba, whose weight was estimated at 30,000 lbs.; and another was found at Bahia, in Brazil, whose solid contents are at least twenty-eight cubic feet, and weight 14,000 lbs. The Siberian meteorite, discovered by Pallas, weighed originally 1600 lbs., and contained imbedded crystals of chrysolite. Smaller masses are quite common. Meteoric iron is perfectly malleable, and may be readily worked into cutting instruments, and put to the same uses as manufactured iron.

PLATINUM. Platinum cubicum.

Native Platina, *M.* and *J.* Hexahedral Platina, *Haid.* Platina. Gediegen Platina, *W.* and *L.* Polyxen, *Hauy.* Platine Natif Ferrifère, *H.*

Primary form, the cube. In irregular forms and grains. *Cleavage* none.

H.=4—4·5. G.=16—19; 17·332 is the average or most usual specific gravity. *Lustre* metallic. *Streak* and *color* perfect steel-gray; shining. Opaque. Ductile. *Fracture* hackly.

Composition, according to Berzelius, (K. V. Ac. H., 1828, p. 113,)

	Nischne Tagilsk.	Nischne Tagilsk.	Goroblagodat.
Platinum,	78·94	73·58	86·50
Iridium,	4·97	2·35	——
Rhodium,	0·86	1·15	1·15
Palladium,	0·28	0·30	1·10
Copper,	0·70	5·20	0·45
Iron,	11·04	12·98	8·32
Osmium and Iridium,	1·96	Undetermined, 2·30	1·40
	98·75	97·86	98·92,

It is soluble only in heated nitro-muratic acid. Not fusible in the flame of the common blowpipe. It acts slightly on the magnet; this property depends on the amount of iron it contains.

Obs. Platinum was first found in pebbles and small grains, associated with iridium, rhodium, osmium, palladium, gold, copper, and chrome, in the alluvial deposits of Brazil, Choco, and Barbacoa, in South America, where it received its name, *platina*, from *plata*, *silver*, of which word platina is a diminutive. It has of late years been discovered in considerable abundance at Nischne Tagilsk, and Goroblagodat, in the Uralian mountains, and has been formed into coins of eleven and twenty-two rubles each, by the Russians. They are not a legal tender, but pass conventionally, and are principally current in the southern provinces of the empire. Platinum is also found on Borneo.

Although platinum generally occurs in quite small grains, masses are sometimes found of considerable magnitude. A mass, weighing 1088 grains, was brought by Humboldt from South America, and deposited in the Berlin museum. Its specific gravity was 18·94. In the year 1822 a mass of platinum from Condoto was deposited in the Madrid museum, measuring two inches and four lines in diameter, and weighing 11,641 grains. A more remarkable specimen was found in the year 1827, in the Ural, not far from the Demidoff mines, which weighed $10\frac{5}{96}$ Russian pounds, or 11·57 pounds troy, and similar masses are now not uncommon; the largest yet seen weighed 21 pounds troy, and is in the Demidoff cabinet.

The infusibility of this metal, and its property of resisting the action of the air and moisture, and nearly all chemical agents, render it highly valuable for the construction of optical and chemical apparatus. The vessels employed in the concentration of sulphuric acid are now made of platinum, which is unaffected by this corrosive acid. Platinum is also employed for covering other metals, and for painting on porcelain. It admits of

being drawn into wire of extreme tenuity. Dr. Wollaston succeeded in obtaining a wire not exceeding the two thousandth of an inch in diameter.

The metal platina was first discovered by Ulloa, a Spanish traveler in America, in the year 1735.

IRIDOSMINE. IRIDIUM HEXAGONUM.

Rhombohedral Iridium, *Haid.* Native Iridium. Iridosmine. Alloy of Iridium and Osmium.

Primary form, a hexagonal prism. *Secondary form*: fig. 125, Pl. II. P : e=136° 28′, e : e=139° 56′, P : e″=117°. *Cleavage* sal, easily obtained; lateral, indistinct. Commonly in irregular attened grains.

H.=6—7. G.=19·5, Wollaston; 19·471, Rose, a crystal at 52°; 21·118, a crystal from Nischne Tagilsk in Siberia. *Lustre* metallic. *Color* tin-white, and light steel-gray. Opaque. Malleable with difficulty.

There are three or four varieties of this species, which have been described by Berzelius as occuring in Siberia, (Pogg. xxxii.) The first consists of flat plates, possessing no regular form, and a hardness sufficient to scratch glass. G.=19·25. They contain, according to Berzelius, Iridium 46·77, osmium 49·34, rhodium 3·15, iron 0·74, which is nearly equivalent to an atom each of iridium and osmium.

The second variety is found in plates. G.=18·645—19·25.

The remaining varieties occur in six-sided plates. G.=21·118. One contains iridium 25·1, and osmium 74·9, or one atom of the former to three of the latter; the other, iridium 20, and osmium 80, or one atom of iridium to four of osmium.

At a high temperature some of these varieties give out a little osmium, but undergo no further change. With nitre, the characteristic odor of osmium is soon perceived and a mass obtained soluble in water, from which a green precipitate is thrown down by nitric acid.

OBS. It occurs with platinum in the province of Choco in South America, and in the Ural mountains. It was first distinguished by Dr. Wollaston, who discovered that the specimens were an alloy of iridium and osmium.

Breithaupt proposes to rank this species with the pyrites, and considers it plesiomorphous with magnetic pyrites.

PALLADIUM. PALLADIUM OCTAHEDRUM.

Octahedral Palladium, *Haid.* Native Palladium. Selenpalladite.

Primary form, supposed to be the regular octahedron. Occurs mostly in grains apparently composed of diverging fibres.

H. above 4·5. G.=11·8, Wollaston; 12·14, Lowry. *Lustre* metallic. *Color* steel-gray, inclining to silver white. Opaque. Ductile and malleable.

It consists of palladium, alloyed with a little platinum and iridium. Infusible alone before the blowpipe, but fuses readily with sulphur. By continuing the heat, the sulphur is driven off, and a globule of palladium obtained.

OBS. Palladium occurs with platinum, in Brazil. Its divergent structure distinguishes it from the latter metal. It was first made known by Wollaston.

The *Selenpalladite* of Zinken from Tilkerode has been lately acknowledged by him to be native palladium. The *Eugenesite* of Zinken, from the same locality, contains, according to this author, palladium, silver, and gold, with selenium. Rammelsberg suggests that the selenium may proceed from a mechanical mixture with selenid of lead.

GOLD. AURUM CUBICUM.

Hexahedral Gold, *M.* Native Gold. Gediegen Gold, *W.* Electrum, *Haus.* Or Natif, *H.* Sol *Alchym.* Rex Metallorum.

Primary form, the cube. *Secondary form:* figs. 2—11, inclusive, Plate I, also figs. 14, 15, 16. *Cleavage* none. *Compound crystals:* composition similar to that represented in fig. 129, Plate II, but occurring in the form exhibited in fig. 16, Plate I. *Imperfect crystallizations:* filiform, reticulated, and arborescent shapes—also in thin laminæ; also in imbedded grains and rolled masses.

H.=2·5—3. G.=12—20. *Lustre* metallic. *Streak* and *Color* various shades of gold-yellow, sometimes inclining to silver-white. Opaque. Very ductile and malleable.

The ores of gold in nature usually contain silver in different proportions. The largest proportion of silver is found in the *electrum* of Klaproth, which is composed of Gold 64, and silver 36, or two of gold to one atom of silver.

The native gold of Marmato is composed of Gold 73·45, silver 26·48, or three parts of gold to one of silver. Its specific gravity is only 12·666; as determined by Boussingault. The proportion of three and a half to one has been found by Rose in the gold of Titiribi, in Columbia; that of five to one by Boussingault in gold from Trinidad; six to one by Boussingault in specimens from Ojas Anchas, and by G. Rose in specimens from near Nischne Tagilsk, in Siberia, and St. Barbara, Transylvania. The proportion of eight to one is the most abundant; such is the proportion in a specimen from Gotzuschka, near Nischne Tagilsk, which Rose found to contain (Pogg. xxiii, p. 177) 87·17 of Gold, and 12·41 of silver; also in numerous others analyzed by the same chemist, and also by Boussingault. That of twelve to one is also of frequent occurrence. Boussingault found a specimen from St. Bartholomé to contain Gold 91·9, and silver 8·1; another from Girar to be composed of Gold 91·9, and silver 8·1; in each of which, the proportion of gold to silver is that last stated. A similar composition was found by Rose, for specimens from different localities: one from Boruschka contained Gold 91·36, and silver 8·38. The least quantity of silver was found by G. Rose, in the native gold of Schabrowski, near Catharinenburg, in Siberia. It consisted of Gold 98·96, silver 0·16, copper 0·35, iron 0·05=99·52. Its specific gravity was 19·099.

Copper is occasionally alloyed with gold, and also palladium and rhodium. The *rhodium gold* has the specific gravity 15·5—16·8. It is brittle, and contains, according to Del Rio, 34 to 43 per cent. of rhodium, and probably should constitute a distinct species.

Obs. Native gold occurs in veins and in interspersed grains and laminæ, and occasionally crystallized in quartz, and is usually associated with talcose rocks. It is often found in the sands of rivers and valleys, where it has been carried from disintegrated auriferous rocks. It also occurs disseminated in grains or thin leaves in various metallic minerals, particularly iron pyrites.

In Brazil, Mexico, and Peru, the gold is mostly obtained from alluvial washings, and is occasionally met with in masses of large size. Pieces from one to fifty lbs. weight were taken from a mass of rock which fell from one of the highest mountains of Paraguay. Several specimens weighing sixteen pounds have been discovered in the Ural, and one of twenty-seven pounds; and in the valley of Taschku-Targanka, October, 1842, a still more extraordinary mass was found detached, weighing one hundred pounds troy. The Russian mines in the Uralian mountains are quite productive. They have afforded annually since their discovery about twenty-two thousand marks, or nearly three and a half million of dollars. The alluvial deposits seldom yield more than sixty-five grains of gold for four thousand lbs. of soil, and never more than one hundred and twenty grains.

Gold is met with in alluvial soil in the Wicklow mountains of Ireland, and at Leadhills, in Scotland. A specimen, weighing nearly eight sovereigns, from the Breadalbane [illegible] near Glen Coich, in Perthshire, is now in the mineralogical cabinet of Mr. Allan, [illegible]nburgh. The mines of Hungary and Transylvania, Kremnitz, Schemnitz, Posing, [illegible] Majurka, Nagyag, Offenbanya, and Boitza, occasionally afford fine specimens of

this metal. It occurs also in Salzburg, and thence in several places along the Alps, as far as La Gardette, near Allemont, in Dauphiny.

The principal deposits of gold in the United States, are situated within the States of Georgia, the Carolinas, and Virginia; but it has been traced as far north as the Chaudière river, in Lower Canada, and is believed to occur in a nearly continuous line from the Rappahanock, in Virginia, to the Coosa, in Alabama. It has been observed at Canaan, in N. H., in decomposing pyrites; at Albion, in Maine, by Dr. Jackson; and by Prof. Hitchcock, at Somerset, in Vermont, along with hydrate of iron and quartz. The mines in North Carolina are mostly within the three ranges of counties between Frederick and Charlotte, which are situated about in a line running N. E. and S. W., corresponding in general with the direction of the coast. The mines at Mecklenburg, which are principally vein deposits, are the most valuable. The mines of Burke, Lincoln, and Rutherford, are for the most part in alluvial soil. Splendid specimens have occasionally been found, the most magnificent of which was discovered in Cabarras county; it weighed twenty-eight lbs. "steelyard weight," was eight or nine inches long by four or five broad and about an inch thick. Within a few feet, two other masses were obtained: one of thirteen and the other eleven lbs. In Virginia, valuable deposits occur in Spotsylvania Co., ten miles above Fredericksburg, on the Rappahanock river, at the United States gold mines; accompanying silver, lead, and Vivianite, at the Rappahanock gold mines, Stafford Co., ten miles from Falmouth; in quartz and decomposed pyrites, at the Culpepper mines, Culpepper Co., on Rapidan river; in auriferous pyrites distributed through veins of quartz, lying in hornblende slate, at Orange grove gold mine, Orange Co.; in quartz, and also in alluvial deposits, at the Greenwood Gold mines, Orange Co.; in beds of quartz, from one to two feet thick, associated with iron pyrites, copper pyrites, blende, argentiferous galena, spathic iron, and Anglesite, at Walton's gold mine, Louisa Co. About $100,000 have been obtained by washing along the streams in the vicinity of this mine. It accompanies granular heavy spar, in auriferous pyrites, at Eldridge's mine, in Buckingham Co., and occurs in various other parts of the State.

Gold is the most ductile and malleable of the metals. According to Dr. Ure, a grain in the form of gold leaf may be made to cover fifty-six and three quarter square inches; and Reaumur states, that a grain, extended to the thinness it has upon gilt silver wire, will cover an area of fourteen hundred inches. The thinnest gold leaf is the two hundred and eighty thousandth part of an inch thick. On account of the extreme malleability of this costly metal, it is one of the cheapest and most common means of ornamenting furniture, &c. It retains its lustre uninfluenced by moisture and the atmosphere, and for this reason is well fitted for the various ornamental uses, and for the numerous purposes in the arts, to which it is applied.

The name *electrum* was applied by the ancients to an alloy of silver and gold, in the proportion of one to five. This is the origin of Klaproth's name for a similar native alloy.

SILVER. ARGENTUM OCTAHEDRUM.

Hexahedral Silver, *M.* and *J.* Native Silver. Gediegen Silber, *W.* Argent Natif, *H.*

Primary form, the regular octahedron. *Secondary forms*: figs. 2, 3, 4, 16, and others intermediate, Pl. I. *Cleavage* none. *Compound crystals*: fig. 129, Pl. II. *Imperfect crystallizations*: coarse and fine filiform, reticulated and arborescent shapes; also in plates, and in superficial coatings.

H.=2·5—3. G.=10·4743, Haüy; 10·338, Gellert. *Lustre* metallic. *Streak* shining metallic. *Color* silver-white; subject to tarnish, by which the color becomes grayish-black. Ductile.

Native silver is usually an alloy of silver and copper. Composition, according to Berthier, of specimens from Carey, (Ann. des M. xi, 72,) is silver 90 and copper 10. It is also combined with gold in various proportions, as is stated under Gold. Fordyce obtained from an alloy of this kind, silver 72, and gold 28; and Klaproth, from another ore, obtained silver 36, and gold 54. Probably some of the compounds of gold and silver constitute distinct species, when their peculiarities shall have been more studied.

readily in the blowpipe flame, and affords on cooling a globule, having an angular crystalline form. Dissolves in nitric acid and heated sulphuric acid.

Obs. Native silver occurs principally in arborescences and filiform shapes, in veins of calcareous spar or quartz, traversing gneiss slate, and other primitive rocks. The structure of these forms is sometimes quite peculiar; they being composed of one or more series of octahedrons, either closely united or arranged perpendicularly in straight rows. This structure is apparent in most of the Norwegian and Mexican varieties.

The mines of Kongsberg in Norway, formerly afforded magnificent specimens of native silver; they are now, for the most part, under water. One specimen among the splendid suite from this locality, in the royal collection at Copenhagen, weighs upwards of 5 cwt. The principal Saxon localities are at Freiberg, Schneeberg, and Johanngeorgenstadt; the Bohemian, at Przibram, Joachimstahl, and Ratinborzitz. It also occurs in small quantities, with other ores, at Andreasberg, in the Hartz, in Suabia, Hungary, at Allemont in Dauphiny, and in some of the Cornish mines. A mine on the estate of Alva, in Stirlingshire, about the middle of last century, afforded £40,000 or £50,000 of silver; but it was long since abandoned.

Mexico and Peru are at present the most productive countries in silver. In Mexico it has been obtained mostly from its ores, while in Peru it occurs principally native. During the first eighteen years of the present century, more than 8,180,000 marks of silver were afforded by the mines of Guanaxuato alone. Of the 8,000,000 sterling, which it is calculated is the value of silver annually afforded by the mines of the world, about two thirds are obtained from Mexico.

The United States have afforded but little native silver. It has been observed at a mine a mile south of Sing Sing prison, which was worked for silver during the Revolution; at the Bridgewater copper mines, New Jersey; in interesting specimens at King's mine, Davidson Co., N. C.; also at the copper mines of Michigan.

The uses of silver, as a material for coins, also in the manufacture of plate and various articles of luxury, are well known. For coinage it is alloyed in this country with 10 per cent. of copper, by which it is rendered harder, and consequently more durable. It is less malleable than gold, and cannot be beaten into unbroken leaves thinner than the one hundred and sixty thousandth part of an inch, which is more than one third thicker than gold leaf.

MERCURY. Hydrargyrum fluidum.

Fluid Mercury, *M.* Native Mercury, or Quicksilver. Gediegen Quecksilber. Mercure Natif, *H.* Hydrargyrum. Argentum Vivum. Spuma argenti. Liquor Æternalis, *Pliny.* Mercurius *of the Alchemists.*

Primary form, the regular octahedron. Occurs in small fluid globules scattered through its gangue.

G.=13·568. *Lustre* metallic. *Color* tin-white. Opaque.

Entirely volatile before the blowpipe, vaporizing at the temperature of 662° F.; becomes solid at —39° F., and with a little care will then crystallize in octahedrons. Dissolves readily in nitric acid.

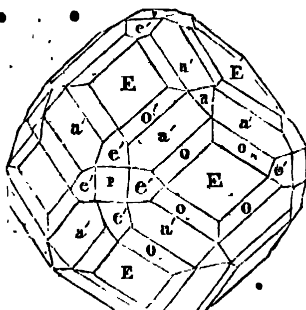
Obs. Fluid mercury is a rare mineral; the quicksilver of commerce is mostly obtained from cinnabar, one of its ores. Its most important mines are those of Idria in Carniola, and Almaden in Spain. At Idria it occurs interspersed through a kind of slate-clay, from which it is obtained by washing. The Idria mines, at the present time, afford annually, from its ores and the native metal, about 164 tons, which is a less quantity than formerly. Native mercury is also found in small quantities at Wölfstein and Morsfeld, in the Palatinate, in Carinthia, Hungary, Peru, and other countries. It has been lately discovered at Peyrat le Chateau, in the department of the Haute Vienne, in a disintegrated granite, unaccompanied by cinnabar.

Mercury is used for the extraction of gold and silver ores, and is exported in large quantities to South America. It is also employed for silvering mirrors, for thermometers and barometers, for percussion powders, and for various other purposes connected with medicine and the arts.

The common name of this metal, quicksilver, is a translation of the old name, argentum vivum.

AMALGAM. HYDRARGYRUM DODECAHEDRUM.

Dodecahedral Mercury, *M.* Native Amalgam. Naturlich Amalgam, *W.* Amalgam, *Haus.* and *L.* Mercure Argentif, *H.*



Primary form, the rhombic dodecahedron. *Secondary forms:* figs. 4, 6, 8, 9, 16; Pl. I, also the annexed figure. *Cleavage* dodecahedral, in traces. Also massive.

H.=2—3·5. G.=10·5—14; 13·755, Haidinger. *Lustre* metallic. *Streak* and *color* silver-white. Opaque. *Fracture* conchoidal, uneven. Brittle. A grating noise when cut with a knife.

Composition, according to Klaproth (Beit. i, 182) and Cordier, (Phil. Mag. xiv, 41,)

Mercury,	64	72·5
Silver,	36=100, K.	27·5=100, C.

The first of these analyses corresponds nearly to two atoms of mercury and one of silver; the second to three atoms of mercury and one of silver.

The mercury volatilizes before the blowpipe, and leaves a globule of pure silver. When rubbed on copper it communicates to it a silvery lustre. It dissolves in nitric acid.

OBS. This rare species occurs principally in the Palatinate, at Moschellandsberg, where large and highly modified crystals are occasionally found. It is associated with mercury and cinnabar, in ferruginous and argillaceous veins, and is said to occur where the veins of mercury and silver intersect one another. It has also been found at Rosenau, in Hungary, and in the mine of Sala in Sweden.

The *Arquerite* of Berthier is a silver amalgam from Coquimbo, consisting of silver 86·5, and mercury 13·5, (Compt. Rend. xiv, 567.)

LEAD. PLUMBUM OCTAHEDRUM.

Hexahedral Lead, *Haid.* Gediegen Blei, *L.* Plomb Natif. Saturnus *of the Alchemists.* Plumbum nigrum.

Primary form, the regular octahedron. In delicate membranes, and in small globular masses.

H.=1·5. G.=11·3523, Haüy. *Lustre* metallic. *Color* lead-gray. Opaque. *Fracture* hackly. Malleable and ductile.

Fuses readily, and covers the supporting charcoal with a yellow oxyd.

OBS. This species is reported as occurring at Alston in Cumberland, in minute globules imbedded in galena. It has been observed in the lava of Madeira, and in an argillaceous rock at Carthagena. It has been described as forming delicate membranes in the cleavage joints of galena on the Anglaise river, Ohio.

The uses of lead are too well known to require enumeration.

BISMUTH. BISMUTUM OCTAHEDRUM.

Octahedral Bismuth, *M.* Native Bismuth, Gediegen Wismuth, *W.* Bismuth Natif, *H.* Bisemutum, *Agricola.* Plumbum Cinereum. Tectum Argenti. Antimonium Femininum.

Primary form, the regular octahedron. *Cleavage* octahedral, highly perfect. Also in reticulated and arborescent shapes; foliated and granular.

H.=2—2·5. G.=9·737. *Lustre* metallic. *Streak* and *Color* silver-white, with a reddish hue; subject to tarnish. Opaque. *Fracture* not observable. Sectile. Brittle when cold, but when heated may be malleated.

It is pure bismuth, excepting occasionally a slight admixture of arsenic. Fuses readily; fusing temperature 476° F. Before the blowpipe it evaporates, and leaves a yellow coating on the charcoal. It dissolves in nitric acid; subsequent dilution causes a white precipitate. Crystallizes readily from fusion.

Bismuth occurs in veins which traverse gneiss and clay slate accompanying various ores of silver, cobalt, lead, and zinc. It occurs most abundantly at the silver and cobalt mines of Saxony and Bohemia, Schneeberg, Annaberg, Altenberg, Joachimstahl, Johanngeorgenstadt, &c. It has also been found at Modum in Norway, and Fahlun in Sweden. At Schneeberg it forms arborescent delineations in brown jasper. At Wheal Sparnon, near Redruth, and at Carrock Fell in Cumberland, it is associated with ores of cobalt; formerly it was met with near Alloa in Stirlingshire

Lane's mine in Monroe, Conn., is its only known locality in the United States; it is there associated with wolfram, tungstate of lime, galena, blende, &c., and is imbedded in quartz.

Bismuth is employed in the formation of type metal, pewter, solder, &c. It is one of the constituents of the alloy, called, from its extreme fusibility, *fusible metal*, which melts at a temperature below that of boiling water; the constituents of this alloy are eight parts of bismuth, five of lead, and three of tin. It is sometimes used for taking casts of delicate objects that would be destroyed by heat.

BISMUTH SILVER. Bismutum argenticum.

Bismuthic Silver ore. Wismuth Silber *of the Germans*. Bismuth Sulfuré Plombo-Argentifère, *Levy*.

Rarely presents acicular or capillary crystallizations; generally in amorphous masses.

Soft. *Lustre* metallic. *Color* tin-white or grayish; subject to tarnish. Opaque. *Fracture* uneven. Sectile.

Composition. Bismuth 27, lead 33, silver 15, iron 4·3, copper 0·9, sulphur 16·3. Soluble in nitric acid. Before the blowpipe it fuses readily to a silver button, covering the charcoal with the oxyds of lead and bismuth.

Obs. Bismuth silver accompanies copper pyrites, in amorphous masses, at Schapbach, in the valley of Kinzig in Baden. It is worked as an ore of silver.

COPPER. Cuprum octahedrum.

Octahedral Copper, *M.* and *J.* Gediegen Kupfer *of the Germans*. Cuivre Natif, *H.* Venus *Alchem*.

Primary form, the regular octahedron. *Secondary forms*: figs. 1—11 inclusive, Pl. I. *Cleavage* none. *Compound crystals*; composition parallel to a face of the octahedron; variously modified. *Imperfect crystallizations*: arborescent and filiform shapes; amorphous.

H.=2·5—3. G.=8·5844, Haüy. *Lustre* metallic. *Streak* metallic shining. *Color* copper-red. Ductile and malleable. *Fracture* hackly.

It consists purely of copper. Before the blowpipe it fuses readily; on cooling, it is covered with a coating of black oxyd. It dissolves readily in nitric acid, with the extrication of the red fumes of nitrous acid, and produces a blue solution with ammonia.

Obs. Copper occurs in beds and veins accompanying its various ores, and sometimes associated with iron. It is frequently found in loose masses imbedded in the soil.

The finest crystalline specimens are brought from Siberia and the island of Nalsoe, in Faroe, where it is associated with fibrous mesotype in amygdaloid, and though mostly disseminated in minute particles, it sometimes branches through the rock with extreme beauty. Cornwall, and many of the mines near Redruth, however, are the greatest repositories of this metal; it also occurs in considerable quantities at the Consolidated mines, Wheal Buller, and others. Its crystallizations are seldom regular, but usually lengthened, and grouped in elongated series, similar to native silver. Brazil also affords native copper; a mass now in the museum at Lisbon, supposed to be from a valley near Bahia, weighs 2616 pounds.

This metal has been found native throughout the red sandstone region of the United States, particularly in Massachusetts, Connecticut, and still more abundantly in New Jersey, where it has been met with at several different places, sometimes in fine crystalline masses, especially at Brunswick, Somerville, Schuyler's mines, and Flemington. One mass from near Somerville, on the premises of J. C. Van Dyke, Esq., of Brunswick, weighs 78 pounds, and is said originally, to have weighed 128. Near Brunswick a vein or sheet of copper, from $\frac{1}{16}$ to ¼ of an inch thick, has been traced for several rods. Near New Haven, Conn., a mass was formerly found weighing 90 pounds. Still larger masses occur in Northern Michigan, lately explored by Prof. Houghton; and some of extraordinary size were observed near Lake Superior by Mr. Henry R. Schoolcraft on his exploring tour in 1821. In the Yale College cabinet there is a large irregular mass weighing 137 lbs. from the vicinity of Lake Superior, near On-ta-naw-gaw river. The large mass seen by Mr. Schoolcraft on the west bank of this river, and described as weighing 2200 lbs., (Sill. Jour. iii, 201,) was brought to the city of Washington during the year past.

Coppor is of very extensive application in the arts. In the pure state, it is used for various utensils, the sheathing of ships, &c. Alloyed with zinc, it constitutes brass, and with tin, it forms bell-metal. A similar alloy, in different proportions, constitutes the material of which the ancients made their *brass* weapons and cutting instruments. The proportion in these instruments was about five of copper to one of tin, which is the ratio that affords an alloy of maximum hardness. This was the constitution of an ancient dagger, analyzed by Hielm.

The term *χαλκος*, or *æs*, which was applied to this material, was also a general appellation for copper, and the various alloys in which it was the principal ingredient.

TELLURIUM. Tellurium hexagonum.

Native Tellurium, *M.* and *P.* Hexahedral Tellurium, *P.* Gediegen Sylvan, *W.* Gediegen Tellur, *Haus.* and *L.* Tellure Natif Auro-Ferrifère, *H.*

It has been found in crystals, which, according to Mr. W. Phillips, are regular six-sided prisms, with the terminal edges replaced; P : e=122° 24′. *Cleavage* undetermined. It also occurs massive and granular.

H.=2—2·5. G.=5·7—6·1, Phillips. *Lustre* metallic. *Streak* and *color* tin-white. Brittle.

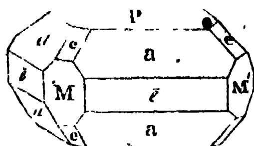
Composition, according to Klaproth, (Beit. iii, 2,) Tellurium 92·55, iron 7·2, and gold 0·25. A specimen from Nagyag afforded Petz, (Pogg. lvii, 1842. 477,) Tellurium 97·215, and gold 2·785, with a trace of iron and sulphur. It fuses readily on charcoal, burning with a greenish flame, and volatilizes almost entirely in white vapors.

Obs. Native tellurium has hitherto been found only at the mine of Maria Loretto, at Facebay, near Zalathna in Transylvania, where it occurs in sandstone, accompanying quartz, iron pyrites, and gold. About forty years since it was found in considerable abundance, and was melted to extract the small quantity of gold it contains. At present it is very rare.

Thin coatings of *telluric acid* have been observed by Petz, along with native tellurium.

AURO-TELLURITE. Tellurium rhombicum.

Yellow Ore of Tellurium. White Ore of Tellurium. Weisstellur.



Primary form, a right rhombic prism. *Secondary form:* M : ē=142° 45′, M : ē 127° 15′, P : a=108° 30′, P : *a*=143° 5′. *Cleavage* in traces. Occurs in small crystals and imbedded crystalline laminæ.

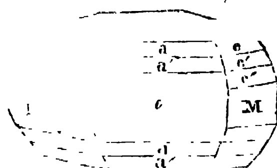
Soft. G.=10·678. Muller Von Reichenstein. *Lustre* metallic. *Color* silver-white, much inclining to brass-yellow. Opaque. Rather brittle.

Composition, according to Klaproth, (Beit. iii, 28,) Tellurium 44·75, gold 26·75, silver 8·50, lead 19·50, sulphur 0·50. Before the blowpipe it fuses to a metallic globule, and gives out a pungent odor. It is soluble in nitric acid.

Obs. The only known locality is at Nagyag, in Transylvania, where it is associated with graphic gold and manganblende.

GRAPHIC TELLURIUM. Tellurium graphicum.

Prismatic-Antimony Glance, *M.* Graphic Gold. Schrifterz. Tellure Natif Auro-argentifère, *H.*



Primary form, a right rhombic prism: M : M=107° 44′. *Secondary form:* P : a=141° 30′, P : a′=129° 12′, P : e=151° 40′, P : e′=136° 42′, P : e″=132° 45′. *Cleavage* highly perfect parallel with M; less so parallel with P. *Compound crystals:* prismatic crystals intersect at 60° and 120°, nearly. *Imperfect crystallizations:* structure imperfectly columnar and granular.

H.=1·5—2. G.=5·723. *Lustre* metallic. *Streak* and *color* pure steel-gray. *Fracture* uneven. Very sectile.

Composition, according to Berzelius, (Jahresb. 1833, p. 162,) Tellurium 52, silver 11·33, gold 24, iron 1·50=88·83, together with some copper, iron, antimony, sulphur, and arsenic. It fuses easily, tinging the flame greenish-blue, and covering the charcoal with a white oxyd; finally a ductile metallic globule is obtained. Dissolves in nitric acid.

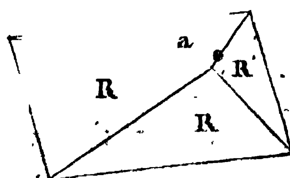
Obs. It occurs with gold at Offenbanya in Transylvania, in narrow veins, which traverse porphyry; also at Nagyag in the same country.

Its name alludes to the peculiar arrangement of the crystals, resembling writing characters.

The large amount of gold it contains, renders it a highly valuable ore.

NATIVE ANTIMONY. Stibium rhombohedrum.

Rhombohedral Antimony, *M.* Dodecahedral Antimony, *J.* Native Antimony, Gediegen Antimon, Spiesglas, *W.* Gediegen Spiessglanz, *Haus.* Antimoine Natif, *H.*



Primary form, an obtuse rhombohedron; R : R=117° 15′. *Secondary form:* the annexed figure. *Cleavage* highly perfect and producing a surface of splendent lustre, parallel to a, also distinct, parallel with R. Seldom in crystals: generally massive, structure lamellar.

H.=3—3·5. G.=6·72, Klaproth; 6·646, a Swedish variety. *Lustre* metallic. *Streak* and *color* tin-white. Rather brittle; not ductile.

Composition, according to Klaproth, (Beit. iii, 169,) Antimony 98, silver 1, and iron 0·25=99·25. Before the blowpipe it soon melts to a globule, which continues to burn though the heat be removed; a continuation of the heat causes it to evaporate in white fumes, which are deposited around the globule. Under the microscope, yellowish-white octahedrons, probably of antimonous acid, are seen to be first formed, and subsequently, prismatic crystals of oxyd of antimony, with which at last the whole globule is covered. It crystallizes readily from fusion.

Obs. It occurs in lamellar concretions in limestone at Sahlberg, near Sahla, in Sweden; at Andreasberg in the Hartz; in argentiferous veins in gneiss at Allemont in Dauphiny; at Przibram in Bohemia; in Mexico, and other places. It is often accompanied by the following species, from which, however, it is readily distinguished by means of the blowpipe. Antimony is variously employed in the arts, and for pharmaceutical preparations. One part of antimony is alloyed with sixteen parts of lead in the formation of type metal. With tin, it forms the metal on which music is engraved.

ANTIMONIAL SILVER. STIBIUM RHOMBICUM.

Prismatic Antimony, *M.* Octahedral Antimony, *J.* Antimoniet of Silver, Spiesglas-Silber, *W.* Silber Spiessglanz, *Haus.* Antimon Silber, *L.* Argent Antimonial, *H.*

Primary form, a right rhombic prism. *Cleavage* parallel to P distinct. *Compound crystals:* similar to those of Arragonite and white lead ore. *Imperfect crystallizations:* composition granular, particles of various sizes, weakly coherent.

H.=3·5—4. G.=9·44—9·8; 9·4406, Haüy. *Lustre* metallic. *Streak* and *color* silver-white, inclining to tin-white. Opaque. *Fracture* uneven.

Composition, according to Klaproth (Beit. ii, 298, and iii, 173) and Vauquelin, (Haüy, iii, 392,).

Silver,	84	76	77	78
Antimony,	16=100, K.	24=100, K.	23=100, K.	22=100, V.

Before the blowpipe gray fumes of antimony are given off, and a gray metallic globule, which is not malleable, is left. By continuing the heat, the silver is obtained.

Obs. It occurs in veins at Altwolfach in Furstenberg, Wittichen in Swabia, and at Andreasberg in the Hartz, associated with several ores of silver, native arsenic, and galena, and other species.

If found in sufficient quantity, this would be a valuable ore of silver; but it is yet a rare mineral.

NATIVE ARSENIC. ARSENIUM RHOMBOHEDRUM.

Native Arsenic, *M.* Gediegen Arsenik, *W.* Arsenic Natif, *H.* Arsenicum. Αρρενικον, Αρσενικον.

Primary form, an obtuse rhombohedron; R : R=114° 26′. *Cleavage* imperfect parallel with a. Presents also reticulated, reniform, and stalactitic shapes; structure columnar or granular: when the former, cleavage is observed perpendicular to the axis of the individual.

H.=3·5. G.=5·672, Harepath. It varies from 5·67—5·93. *Lustre* metallic. *Streak* and *color* tin-white, tarnishing soon to dark-gray.

When heated it volatilizes in white fumes, having the odor of garlic; if heated nearly to redness it burns with a pale bluish flame, giving out alliaceous fumes.

OBS. Native arsenic commonly occurs in veins in primitive mountains, and is often accompanied by red silver ore, realgar, blende, and other metallic minerals.

The silver mines of Freiberg, Annaberg, and Schneeberg, afford this metal in considerable quantities. It occurs also at Joachimstahl in Bohemia, at Andreasberg in the Hartz, at Kapnik in Transylvania, at Orawitza in the Bannat, at Zincoff in Siberia, in large masses, and at St. Marie aux Mines in Alsace.

In the United States it has been observed by Jackson at Haverhill, N. H., on the estate of Mr. Francis Kimball, in thin layers in dark blue mica slate, stained by plumbago, and containing also white and magnetic pyrites; also at Jackson in the same State.

Its peculiar odor when heated, which is also apparent when struck with a hammer, is quite characteristic.

Arsenic is a virulent poison. It is employed in several pharmaceutical preparations. It is also used in giving a peculiar tint to glass, and in various metallurgical operations.

The name Arsenic, is derived from the Greek, αρσενικον, or αρρενικον, *masculine*, a term applied to orpiment or sulphuret of arsenic, on account of its potent properties.

ORDER IX. PYRITINEA.

NICKEL STIBINE. NICCOLITES EUTOMUS.

Eutomous Cobalt-Pyrites, *M.* Nickeliferous Gray Antimony, Nickelspiesglanzerz, and Nickelantimonglanz *of the Germans.* Antimoine Sulfuré Nickelifère, *H.*

Primary form, the cube. *Cleavage* cubic, perfect. Occurs also massive; structure granular.

H.=5—5·5. G.=6·451, a cleavable variety. *Lustre* metallic. *Color* steel-gray, inclining to silver-white. Brittle.

Composition, according to Klaproth (Beit. vi, 329) and Rose, (Pogg. xv, 588,)

Nickel,	25·25	27·36	28·04
Antimony,	47·75	55·76	54·47
Sulphur,	15·25	15·98	15·55
Arsenic,	11·75=100, K.	—=99·10, R.	—=98·06, R.

In the blowpipe flame it is partly volatilized, and the charcoal is covered with a white coating. Ultimately it fuses to a metallic globule, which communicates a blue color to glass of borax.

OBS. It occurs in the duchy of Nassau, in the mines near Freusberg, associated with sparry iron, galena, and copper pyrites.

ANTIMONIAL NICKEL. NICCOLITES HEXAGONUS.

Antimoniet of Nickel. Antimonnickel

Primary form, a hexagonal prism. *Secondary form:* thin hexagonal plates.

H.=about 5·5—6. G.=7·541, Breithaupt. *Lustre* metallic, splendent. *Streak* reddish-brown. *Color* in the fresh fracture light copper-red, inclining strongly to violet. Opaque. *Fracture* uneven—small subconchoidal. Brittle. Not acted on by the magnet.

Composition; according to Stromeyer, (Pogg. xxxi, 134,) Nickel 28·946, antimony 63·734, iron 0·866, galena 6·437=99·983. Some antimony sublimes before the blowpipe.

OBS. It occurs in the Andreasberg mountains, associated with calcareous spar, galena, and smaltine.

COPPER NICKEL. NICCOLITES CUPRICOLOR.

Prismatic Nickel Pyrites, *M.* Arseniet of Nickel, *Thom.* Kupfernickel, *W.* Arseniknickel, *L.* Nickel Arsenical, *H.* Nickelkies. Rothnickelkies.

Primary form, hexagonal. Usually massive—structure nearly impalpable; also reniform, with a columnar structure.

H.=5—5·5. G.=7·33—7·655. *Lustre* metallic. *Streak* pale brownish-black. *Color* copper-red. Opaque. *Fracture* uneven. Brittle.

Composition, according to Pfaff, (Schweig. Jour. xxii, 256,) Berthier, (Ann. des Mines, iv, 471,) and Stromeyer,

Nickel,	48·90	39·94	44·206
Arsenic,	46·42	48·80	54·726
Iron,	0·34	trace	0·337
Sulphur,	0·80	2·00	0·401
Antimony,	——	8·00	——
Lead,	0·56=97·02, P.	Cobalt, 0·16=98·9, B.	Lead, 0·320

Before the blowpipe, on charcoal, it emits arsenical fumes and fuses to a white globule, which darkens by exposure to the air. In nitric acid it soon assumes a green coating, and in nitromuriatic acid is dissolved.

Obs. Copper nickel accompanies cobalt, silver, and copper, in the Saxon mines of Annaberg, Schneeberg, &c.; also in Thuringia, Hesse, and Styria, and at Allemont in Dauphiny. It is occasionally observed in Cornwall.

It is found at Chatham, Conn., in gneiss, associated with smaltine.

Nickel is employed in the manufacture of what is called "German silver," of which it constitutes 17·48 per cent.; the other constituents are copper 53·9, and zinc 29·13.

WHITE NICKEL. NICCOLITES HOFFMANNI.

Binarseniet of Nickel, *Thom.* Weissnickelkies, Arseniknickel.

Primary form, supposed to be the cube. *Secondary forms*: figs. 2 and 5, Pl. I. Occurs also massive.

H.=5·5. G.=7·13. *Lustre* metallic. *Color* tin-white. Opaque. *Fracture* uneven.

Composition, according to Hoffmann (Pogg. xxv, 491) and Booth, (Silliman's J. xxix, 241,)

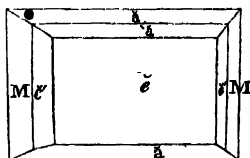
	Richelsdorf.		Schneeberg.
Arsenic,	72·64		71·30
Nickel,	20·74		28·14
Cobalt,	3·37	Bismuth,	2·19
Iron,	3·25	Copper,	0·50
Sulphur,	——=100, H.		0·14=102·27, B.

It evolves arsenical fumes before the blowpipe, and fuses to a brittle metallic button. Fused with salt of phosphorus, it affords a clove-brown transparent glass in the outer, and a brown opaque glass in the inner flame, thus indicating the presence of nickel.

Obs. It occurs in crystals in the cobalt mine of Richelsdorf in Hesse; also massive at Schneeberg, mixed with quartz, and often covered with a thin coating of nickel green.

PLACODINE. NICCOLITES OBLIQUUS.

Plakodin, *Breithaupt*, Pogg. liii, 631, 1841. *Plattner*, Pogg. lviii, 283.



Primary form, an oblique rhombic prism. M : M=64° 32′. *Secondary form:* M : ĕ= 122° 16′, ĕ : ĕ′=133° 28′, ĕ′ : ĕ′ (over ĕ) =86° 54′, ĕ : ă=115° 4′, ĕ : ă=120° 5′. *Cleavage* in traces parallel with M and the shorter diagonal. Occurs also in crystalline masses.

H.=5—5·5. G.=7·988—8·062. *Lustre* metallic. *Color* bronze-yellow, little lighter than magnetic pyrites. *Streak* black. *Fracture* conchoidal—uneven.

Composition, according to Plattner, Arsenic 39·707, nickel 57·044, cobalt 0·910, copper 0·862, sulphur 0·617=99·140.

OBS. This ore of nickel was found at the Jungfer mine, Müssen, where it occurs along with spathic iron and nickel glance. The crystals are tabular, and hence Breithaupt's name, from πλακωδης, *tabular*.

NICKEL GLANCE. NICCOLITES DECREPITANS.

Sulpho-arsenide of Nickel, *Thom*. Nickelglanz. Nickelarsenikglanz. Nickelarsenikkies.

Primary form, the cube. *Secondary forms*: figures 2, 5, 43, Plate I. *Cleavage* cubic, highly perfect. Occurs also in lamellar and granular masses.

H.=5·5. G.=6·097, G. Rose; 6·129, Pfaff. *Lustre* metallic. *Color* silver-white—steel gray. *Streak* grayish-black. *Fracture* uneven.

Composition, according to Berzelius (K. V. Ac. H., 1820, p. 241) and Löwe, (Pogg. lv, 505,)

				Schladming.
Arsenic,	55·50	53·32	48·06	42·52
Nickel,	28·17	27·00	30·80	38·42
Sulphur,	12·67	14·40	19·29	14·22
Iron,	3·63	5·29	2·99	2·09
Silica,	0·61=100·58	——=100·01	1·00=102·14	1·87=99·12, L.

When heated it decrepitates with great violence. Ignited in a glass tube, sulphuret of arsenic sublimes as a transparent yellowish-brown mass, which remains clear on cooling.

OBS. It occurs at Loos in Helsingland, Sweden, and in the Albertine mine, near Harzgerode in the Hartz. It is associated with copper pyrites, galena, calcareous spar, fluor spar, and quartz. It was noticed by Cronstedt, but was first analyzed and described by Pfaff. The higher specific gravity (6·6—6·9) and different composition of the specimens from Schladming, seem to indicate that they form a distinct species. In crystallization and external characters they resemble nickel glance.

CAPILLARY PYRITES. NICCOLITES CAPILLARIS.

Native Nickel, *M.* and *J.* Sulphuret of Nickel. Schwefelnickel, Haarkies *of the Germans*. Nickel Sulfuré, *Levy*.

Primary form, an obtuse rhombohedron, R : R=144° 8′, Miller. *Cleavage* rhombohedral; perfect. Usually in delicate capillary crystallizations.

H. about 3. G.=5·278, Miller. *Lustre* metallic. *Color* brass-yellow, inclining to bronze-yellow and steel-gray. Opaque. Brittle.

Composition, according to Arfvedson, (K. V. Ac. H., 1822, p. 443,) Nickel 64·35, and sulphur 34·26=98·61. Before the blowpipe it fuses to a brittle metallic magnetic globule; it colors glass of borax violet-blue. Forms with warm nitric acid a gray or pale-green solution.

Obs. It occurs in thin capillary crystals in the cavities, and among the crystals of other minerals, at Joachimstahl in Bohemia, Johanngeorgenstadt in Saxony, Andreasberg, Cornwall, and other places. Near Merthyr Tydvil, at Dowlais, it occurs in regular crystals, occupying cavities in nodules of spathic iron.

SULPHURET OF IRON AND NICKEL.

Scheerer, Pogg. lviii, 1843, p. 315.

In crystalline masses cleavable paralle. with the faces of a regular octahedron.

H.=nearly that of magnetic pyrites. G.=4·60. *Lustre* metallic. *Color* light bronze-yellow. *Streak* light bronze-brown; and streak-powder a little darker. Not magnetic.

Composition, according to Scheerer, Sulphur 36·86, iron 40·86, nickel 22·28=100.

In the outer flame of the blowpipe gives with borax the reaction of iron; in the inner a black pearl, opaque, with reduced nickel.

Obs. Occurs disseminated through a hornblende mass, and comes from southern Norway.

BISMUTH NICKEL.

Nickelwismuthglanz *of the Germans*.

Primary form, the regular octahedron. *Cleavage* octahedral.

H.=4·5. G.=5·13. *Lustre* metallic. *Color* light steel-gray to silver-white, often yellowish or grayish through tarnish. Brittle.

Composition, according to Kobell, (Min. 296,) Sulphur 38·46, nickel 40·65, iron 3·48, cobalt 0·28, bismuth 14·11, copper 1·68, lead 1·58=100·24.

Fuses easily before the blowpipe on charcoal, to a gray brittle magnetic bead, and colors the coal yellowish. Gives a greenish solution with nitric acid, depositing at the same time the sulphur.

Obs. This ore occurs at Grunau, in the district of Sayn-Altenkirk, associated with quartz and copper pyrites, and often mixed with the latter.

SMALTINE. Cobalites octahedrus.

Octahedral Cobalt-Pyrites, *M.* Gray Cobalt. Tin-white Cobalt, *J.* Binarseniet of Cobalt, *Thom.* Tesseralkies, *Brei.* Weisser-Speiskobold, *W.* Speisskobalt, *Haus.* and *L.* Cobalt Arsenical, *H.*

Primary form, the regular octahedron. *Secondary forms*: figures 1—10, and fig. 16, Plate I; also several of these forms in combination. *Cleavage* most distinct parallel to the primary faces; also in traces parallel to the faces of the cube and rhombic dodecahedron. *Imperfect crystallizations*: reticulated, and other imitative shapes; granular, coarse or fine.

H.=5·5. G.=6·466—7·2. *Lustre* metallic. *Streak* grayish-black. *Color* tin-white, inclining, when massive, to steel-gray. Opaque. *Fracture* granular and uneven. Brittle.

Composition, according to Stromeyer, (Ann. Phil. x, 228,) Varrentrapp, (Pogg. xlviii, 505,) Scheerer, (Pogg. xlii, 546,) and Wöhler, (Pogg. xliii, 592,)

		Tunaberg. G.=7·131.	Skutterud, Norway.	
Arsenic,	74·2174	69·459	77·84	79·2
Cobalt,	20·3135	23·440	20·01	18·5
Iron,	3·4257	4·945	1·51	1·3
Copper,	0·1586	——	trace	—
Sulphur,	0·8860=99·0012, S.	0·900=98·744, V.	0·69=100·05, S.	—=99·0, W.

The variety from Skutterud is considered by Scheerer and Wöhler a distinct species, and is called *Arsenikkobaltkies.*

The *radiated white cobalt* of Werner, from Schneeberg, contains, according to John, Arsenic 65·75, cobalt 28·00, iron with manganese 6·25=100. Kobell and Hoffman have analyzed the gray speisskobalt from Schneeberg, and found its composition as follows:

Arsenic,	71·08		70·37
Cobalt,	9·44		13·95
Iron,	18·48		11·71
Bismuth,	1·00		0·01
Sulphur,	trace		0·66
Copper,	trace=99·92, K.	Copper and nickel,	3·18=99·88, H

Heated in a candle it emits copious arsenical fumes, and melts to a white brittle metallic globule. It colors borax and other fluxes blue, and produces with nitric acid, a pink solution.

Obs. Smaltine usually occurs in veins, accompanying other ores of cobalt and ores of silver and copper; also, in some instances, with copper nickel and mispickel.

With silver and copper it occurs at Freiberg, Annaberg, and particularly Schneeberg in Saxony; at Joachimstahl in Bohemia, the reticulated varieties are frequently found imbedded in calc spar; also at Wheal Sparnon in Cornwall, and at Richelsdorf in Hesse, in veins of cupriferous shale.

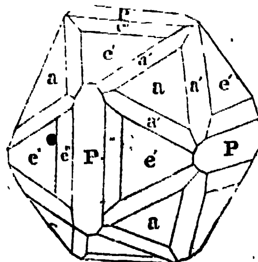
Chatham, Conn., is the only known locality of this mineral in the United States. It there occurs in veins traversing gneiss, associated with mispickel and copper nickel. Deep shafts have been cut into the rock at this place for the purpose or working the ore, but the project is now given up.

The presence of copper nickel, which is a very common associate with this species, is the cause of no small annoyance to the miner; for even a minute quantity suffices to destroy the fine blue color obtained from cobalt. The ore, when separated from this attendant, is roasted to drive off the arsenic, and finely pulverized, and is then prepared for giving the blue color employed in painting porcelain and stone-ware. With silex and potash it affords smalt.

The *Bismuth cobalt ore* of Karsten is supposed to be a mechanical mixture of smaltine and sulphuret of bismuth.

COBALTINE. Cobalites hemi-cubicus.

Hexahedral Cobalt-Pyrites, *M.* Silver-White Cobalt. Bright White Cobalt. Glance Cobalt. Sulpho Arseniet of Cobalt, *Thom.* Glanzkobalt, *W.* Kobalt Glanz, *Haus.* and *L.* Cobalt Gris, *H.*



Primary form, the cube. *Secondary forms:* figs. 42—47 inclusive, Plate I, also the annexed figure. P : e″=166° 30′, P : e′ =153° 26′ 5½″. *Cleavage* cubic; perfect. Planes P longitudinally striated. Occurs also massive; structure granular—fine.

H.=5·5. G.=6·298. *Lustre* metallic. *Streak* grayish-black. *Color* silver-white, inclining to red. *Fracture* uneven and lamellar. Brittle.

Composition, according to Fassaert (Ann. de Ch. xxviii, 100) and Stromeyer, (Ann. of Phil. x, 228,)

		Skutterud.
Cobalt,	36·66	33·1012
Arsenic,	49·00	43·4644
Sulphur,	6·50	20·0840
Iron,	5·66=97·82, T.	3·2324=99·8820, S.

Before the blowpipe it gives off fumes of arsenic, and affords, after roasting, a dull black metallic globule, which attracts the magnet. It colors borax blue, and effervesces in heated nitric acid, like the preceding species.

Obs. It occurs at Tunaberg and Hokansbö in Swedon, in large, splendid, well defined crystals; also at Modum in Norway, where it is mined. Other localities are at Querbach in Silesia, and at Botallick near St. Just, and in other places in Cornwall. The most productive mines are those of Wehna in Sweden, where it occurs in mica slate. These mines were first opened in 1809.

This, and the preceding species, afford the greatest part of the smalt of commerce. It is also employed in porcelain painting.

COBALT PYRITES. Cobaltites cubicus.

Isometric Cobalt-Pyrites, *M.* Sulphuret of Cobalt, *Thom.* Kobaltkies. Schwefelkobalt.

Primary form, the cube. *Secondary forms:* figures 2, 3, and others, Plate I. *Cleavage*, cubic, imperfect. Occurs also massive—structure granular, sometimes impalpable.

H.=5·5. G.=6·3—6·4. *Lustre* metallic. *Color* pale steel-gray, inclining to copper-red when tarnished. Opaque. *Fracture* uneven or subconchoidal.

Composition of the Swedish variety, according to Hisinger, (Afhand. iii, 319,) Cobalt 43·2, copper 14·4, sulphur 38·5, iron 3·53=99·63. It gives off a sulphurous odor when heated, and after roasting, colors glass of borax blue. Dissolves in nitric acid, except the sulphur.

Obs. It occurs in gneiss at Bastnaes near Riddarhyttan in Sweden, associated with copper pyrites and hornblende, and at Mussen near Siegen in Prussia, with heavy spar and carbonate of iron.

ARSENID OF MANGANESE. Manganites alliaceus.

Arseniet of Manganese, *Thom.* Arseniuret of Manganese. Arsenikmangan.

Occurs in botryoidal masses, also amorphous; structure foliated or granular.

H. above 5? stated as hard. G.=5·55. *Lustre* metallic *Color* grayish-white. Opaque. *Fracture* uneven.

Composition, according to Mr. Kane, (Quarterly J. of Sci., new ser., vi, 381,) Manganese 45·5, arsenic 51·8, and a trace of iron=97·3. Before the blowpipe it burns with a blue flame, and falls to powder; at a higher temperature the arsenic evaporates, and covers the charcoal with a white powder. It dissolves in aqua regia, without leaving any residue.

Obs. It is found in Saxony, and was first observed by Mr. R. J. Kane, of Dublin, attached to a mass of galena from that country.

LEUCOPYRITE. Marcasites acrotomus.

Axotomous Arsenical-Pyrites, *M.* Prismatic Arsenical Pyrites, *J.* Glanzarsenikkies. Arsenikeisen, Arsenikalkies. Arsenosiderit.

Primary form, a right rhombic prism; M : M=122° 26′. *Secondary form:* similar to the figure of liroconite, p. 291; a : a=(adjacent planes)=51° 20′. Occurs also massive.

H.=5–5·5. G.=7·228, specimen from Silesia; 7·337, a crystal from Bedford Co., Penn. *Lustre* metallic. *Streak* grayish-black. *Color* between silver-white and steel-gray. *Fracture* uneven. Brittle.

Composition, according to Meyer, Karsten, and Hausmann, (Pogg. 1, 154,)

	Reichenstein.	Reichenstein.	Schladming.
Sulphur,	1·631	1·77	5·20
Arsenic,	63·142	65·88	60·41
Iron,	30·243	32·35	13·49
Gangue,	3·550	——	Nickel and cobalt, 18·47
	98·566, M.	100·00, K.	97·57, H.

Scheerer has analyzed an arsenical iron from Sätersberg near Fossum, Norway, with the following result:

Sulphur 1·28, arsenic 70·22, and iron 28·14.

Obs. It occurs associated with copper nickel at Schladming, in Styria; with serpentine at Reichenstein in Silesia, and at Löling near Hüttenberg in Carinthia, in a bed of sparry iron, associated with bismuth and scorodite.

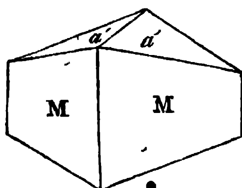
A crystal, weighing two or three ounces, has been found in Bedford Co., Penn., but it is not known under what circumstances. In Randolph Co., N. C., a mass was found weighing nearly two pounds.

The name leucopyrite is derived from λευκος, *white*, and *pyrites*.

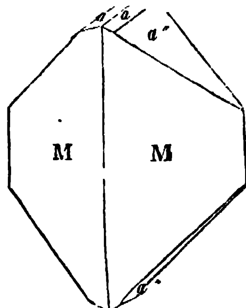
MISPICKEL. Marcasites peritomus.

Prismatic Arsenical Pyrites, *M.* Marcasite. Sulpho-arsenite of Iron. Arsenikkies *of the Germans.* Fer Arsenical, *H.* Danaite.

Primary form, a right rhombic prism; M : M=111° 53′. *Secondary forms:*



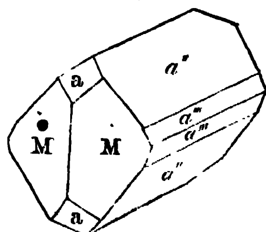
Franconia, N. H.



Franconia, N. H., and Kent, N. Y.

a′ : a′=145° 26′, a : a=118° 32′, a″ : a″=99° 52′ and 80° 8′; according to Teschemacher, a crystal of the cobaltic variety, (Danaite,) figure 3, which is altered in position from Teschemacher's figure,) gives M : M=112°, a : a=121° 30′, a″ : a″=100° 15′; and according to Scheerer, a cobaltic variety from Skutterud in Norway has M : M=111° 40′—112° 2′, and a : a=121° 30′. *Cleavage* parallel to M rather distinct. *Compound crystals:* composition of

3.



the first kind parallel with M. *Imperfect crystallizations*: structure columnar—straight and divergent, or irregular; fine granular, or impalpable—particles strongly coherent.

H.=5·5—6. G.=6·127. *Lustre* metallic. *Streak* dark grayish-black. *Color* silver-white, inclining to steel-gray. *Fracture* uneven. Brittle.

Composition, according to Stromeyer, (Schweig. J. x, 404,) Chevreul, (Gilb. Ann. xvii, 84,) Scheerer, (Pogg. xlii, 546,) Wöhler, (Pogg. xliii, 591,) and Hayes, (Sill. J. xxiv, 386,)

	Freiberg.		Skutterud.	Skutterud.	*Danaite*, Franconia.
Iron,	36·04	34·94	26·36	30·91	32·94
Arsenic,	42·88	43·42	46·76	47·45	41·44
Sulphur,	21·08	20·13	17·34	17·78	17·84
Cobalt,			9·01	4·75	6·45
	100·00, St.	98·49, C.	99·47, Sch.	100·89, W.	98·67, H.

Danaite, and the ores from Skutterud, have part of the iron replaced by cobalt. Scheerer found that the largest crystals contained the largest proportion of cobalt.

On charcoal, before the blowpipe, copious arsenical fumes are driven off, and a globule is obtained of nearly pure sulphuret of iron, which acts on the needle like magnetic pyrites. It gives fire with steel, emitting at the same time an alliaceous odor. It dissolves in nitric acid, with the exception of a whitish residue.

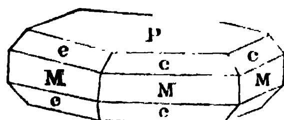
Obs. The localities of mispickel are principally in primitive regions, and its usual mineral associates are silver, lead, and tin, iron and copper pyrites, and blende.

It is abundant at Freiberg and Munzig, where it occurs in veins; and also in beds at Breitenbrun and Raschau, Andreasberg, Joachimstahl, Tunaberg in Sweden; Wheal Mawdlin, and Unanimity, in Cornwall, are other localities.

It is met with in fine crystallizations in gneiss at Franconia, N. H., associated with copper pyrites; also at Jackson, N. H., and at Haverhill: in Maine at Blue Hill, Corinna; Newfield, (Bond's mountain,, and Thomaston. (Owl's head:) massive at Worcester and Sterling, Mass., and in Connecticut at Chatham, with smaltine and copper nickel, at Monroe with wolfram and pyrites: at Derby, in an old mine, associated with quartz; in New Jersey at Franklin: in New York, massive, in Lewis, ten miles south of Keeseville, Essex Co., with hornblende; in crystals and massive near Edenville on Hopkins's farm and elsewhere in Orange Co., with scorodite, iron sinter, and thin scales of gypsum; also in fine crystals at two localities a few rods apart, four or five miles northwest of Carmel, near Brown's serpentine quarry in Kent, Putnam Co.

MAGNETIC PYRITES. Pyrites hexagonus.

Rhombohedral Iron Pyrites, *M*. Sulphuret of Iron. Magnetkies, *W*. Leberkies, *L*. Fer Sulfuré Ferrifère. Fer Sulfuré Magnetique, *H*.



Primary form, a hexagonal prism. *Secondary form*: similar to fig. 125, Pl. II; also the annexed figure. P : e= 134° 52′, M : e=116° 28′, M : e=150°. *Cleavage* perfect parallel with P; less so in the direction of M. Commonly massive and amorphous; structure granular.

H.=3·5—4·5. G.=4·631, a crystalline variety. *Lustre* metallic. *Streak* dark grayish-black. *Color* between bronze-yellow and copper-red. *Fracture* small subconchoidal. Brittle. Slightly attractable by the magnet, and subject to speedy tarnish.

Composition, according to Stromeyer (Gilbert's Annalen, xlviii, 183) and Plattner, (Pogg. xlvii, 371;)

	Hartz.	Pyrenees.	Brazil.
Iron,	59·85	56·37	59·636
Sulphur,	40·15=100, S.	43·63=100, Strom.	40·428=100·064, P.

Before the blowpipe it affords fumes of sulphurous acid and the odor of sulphur. On charcoal in the exterior flame, it is converted into a globule of red oxyd of iron; in the interior flame it fuses and continues to glow, after the blowpipe is removed. The black mass, which is obtained on cooling, is magnetic and has a metallic crystalline structure, and a yellowish color on a surface of fracture. Dissolves in dilute sulphuric acid.

Obs. Crystalline plates of this species have been observed at Kongsberg in Norway, and at Andreasberg in the Hartz; but they are of rare occurrence. It generally occurs massive, in fissures of primitive rocks. Cleavable varieties accompany iolite at Bodenmais in Bohemia. The compact specimens are abundant in Cornwall, at Appin in Argyleshire, in Saxony, Siberia, and the Hartz. It has also been observed in the lavas of Vesuvius, and in some meteoric stones.

Trumbull, Conn., and the adjoining town of Monroe, afford the cleavable variety of this species; at the former place it occurs in the topaz and fluor vein, at the latter in a quartz vein, in gneiss. Compact varieties occur with iron pyrites, at Stafford and Shrewsbury, Vt., and in many parts of Massachusetts; also a mile and a half north of Port Henry, Essex Co., N. Y., near Natural Bridge in Diana, Lewis Co., and with magnetic iron ore at O'Neil mine, and elsewhere, in Orange Co., N. Y.

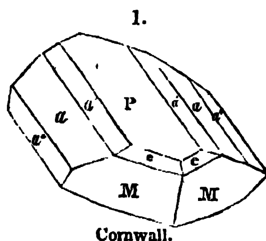
It is mined for its sulphur, and for the fabrication of sulphuric acid and sulphate of iron.

Its inferior hardness is sufficient to distinguish it from the following species.

WHITE IRON PYRITES. Pyrites rhombicus.

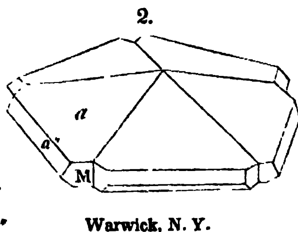
Prismatic Iron-Pyrites, *M.* and *J.* White Iron Pyrites. White Bisulphuret of Iron. Radiated Pyrites, Spear Pyrites. Hepatic Pyrites. Cellular Pyrites. Kammkies, Leberkies, Zellkies, Spärkies, Rhombischer Eisenkies *of the Germans*. Fer Sulphuré Aciculaire Radié, Fer Sulfuré Blanc, *H.* Weisskupfererz and Kyrosite, *Breit.*

1.



Cornwall.

2.



Warwick, N. Y.

Primary form, a right rhombic prism; M : M=106° 36′. *Secondary form*: similar crystals, with merely the modifying planes *a*, have been observed at Warwick, N. Y. P : *a*=130° 55′. *Cleavage* parallel with M, rather perfect. Planes *a* and *a″* longitudinally striated. *Compound crystals*: composition of the first kind—parallel with M. Compound crystals of five individuals, united by the acute lateral angle, are of frequent occurrence. Other compound crystals occur, whose structure depends on composition of the third kind, or parallel to *a*. *Imperfect crystallizations*: globular, reniform, and other imitative shapes—structure straight columnar—impalpable; massive; structure columnar or granular. *Pseudomorphs* in cubes and low nearly regular hexagonal prisms.

H.=6—6·5. G.=4·678—4·847. *Lustre* metallic. *Streak* grayish-black or brownish-black. *Color* pale bronze-yellow, sometimes inclined to green or gray. *Fracture* uneven. Brittle.

Composition, according to Hatchett, (Phil. Trans. 1804, p. 325) and Berzelius, (Schweig. J. xxvii, 67,)

Iron,	46·4	45·66	45·07
Sulphur,	53·6	54·34	53·35
Manganese,	——	——	0·70
Silica,	——=100, H.	——=100, B.	0·80=99·92, B.

Before the blowpipe, on charcoal, it becomes red, the sulphur is mostly volatilized, and an oxyd of iron remains. Some of the varieties are very liable to decomposition.

Obs. This species was formerly subdivided according to the different forms the mineral presents. *Radiated pyrites* included the radiated masses and more simple crystals; *spear pyrites*, the macled crystals; *hepatic pyrites*, or *leberkies*, (so called from ἧπαρ, *liver*,) the decomposed liver-brown tessular crystals which were originally iron pyrites, and also certain hexagonal pseudomorphs; *cockscomb pyrites*, or *kammkies*, the crest-like aggregations of this species of pyrites; *cellular pyrites*, the cellular varieties, formed by the decomposition of crystals of galena which contained films of pyrites between its layers, thus producing a honeycomb appearance.

The spear pyrites occurs abundantly in the plastic clay of the brown coal formation, at Littmitz and Altsattell, near Carlsbad in Bohemia, and is extensively mined for its sulphur and the manufacture of the sulphate of iron. The radiated variety occurs at the same places: also at Joachimstahl, and in several parts of Saxony. The cockscomb variety occurs with galena and fluor spar in Derbyshire. It occurs in stalactitic concretions in Cornwall.

At Warwick, N. Y., it occurs in simple and compound crystals, imbedded in granite, and is associated with zircon. Hustis's farm, in Phillipstown, N. Y., affords small crystals, referred by Beck to this species, occurring in magnesian limestone. Massive fibrous varieties abound throughout the mica slate of New England, and particularly at Cummington, Mass., where it is associated with Cummingtonite and garnet. It occurs also at Lane's mine, in Monroe, Conn., and in the topaz and fluor vein in Trumbull; also in gneiss at East Haddam; at Haverhill, N. H., with common pyrites.

Cockscomb pyrites is employed in the manufacture of sulphur, sulphuric acid, and sulphate of iron, though less frequently than the common iron pyrites. Its color is considerably paler than the ordinary pyrites, and it is also more liable to decomposition.

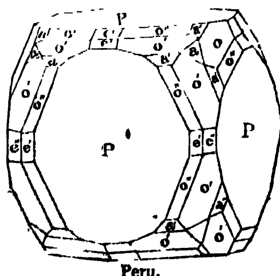
The *Weisskupfererz*, from the mine Briccius, (Kyrosite, *Breit.*,) hitherto considered an arsenid of copper, is shown by Breithaupt to be *white iron pyrites*, with 4 per cent. of copper. It gives M : M=106½° to 107°, and is associated with blue copper and variegated copper ore. The Chilian *Weisskupfererz* contains, according to Plattner, 12·9 per cent. of copper, besides iron and sulphur, but no arsenic. (*Breit.* Pogg. lviii, 281.)

Hydrous pyrites, or *Wasserkies* of the Germans. This mineral, hitherto considered a variety of white iron pyrites, contains water, according to Glocker, in chemical combination. (Pogg. lv, 489.)

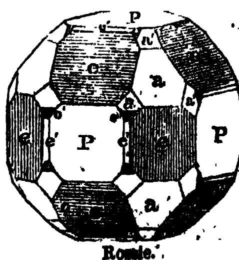
IRON PYRITES. Pyrites cubicus.

Hexahedral Iron-Pyrites, *W* and *J*. Cubic Pyrites. Mundic. Marcasite. Bisulphuret of Iron, *Thom.* Gemeiner Schwefelkies, *W.* Eisenkies, *L.* Fer Sulfuré, *H.* πυρίτης.

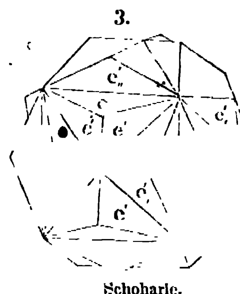
Primary form, the cube. *Secondary forms*: figures 2, 3, 4, 14, 15, 16, 42, 43, 44, 45, 46, 47, 48, Plate I; also the annexed figures.



Peru.



Romé.



P : a=125° 15′ 51¾″, P : a′=144° 44′ 8¼″, P : e″=146° 18′ 36″, P : e′=153° 26′ 6″, P : o′=143° 18′ 3″, P : o″=150° 47′ 39.″ *Cleavage* parallel to the faces of the cube and octahedron, more or less distinct. Planes P and e′ often striated. *Compound crystals:* composition of *the second kind*, parallel to e′. This composition sometimes takes place parallel to each of the edges, when the form in fig. 3 is produced. *Imperfect crystallizations:* imbedded and implanted globules—surface crystalline—structure indistinctly columnar; massive, structure granular—particles strongly coherent.

H.=6—6·5. G.=4·83—5·031. *Lustre* metallic, splendent—glistening. *Streak* brownish-black. *Color* a characteristic bronze-yellow, nearly uniform. Opaque. *Fracture* conchoidal, uneven. Brittle. Strikes fire with steel.

Composition, according to Berzelius, Iron 45·74, sulphur 54·26, and it is, therefore, a bisulphuret of iron. It becomes red in the oxydating flame of the blowpipe, and gives off fumes of sulphur; ultimately, there is obtained a globule of oxyd of iron, which is attractable by the magnet. It is soluble in nitric acid, except a white residue. Some varieties are very liable to decomposition on exposure to the atmosphere.

OBS. Iron pyrites occurs abundantly in rocks of all ages, from the oldest primitive to the most recent alluvial deposits. It usually occurs in small cubes, but often modified as above described; also in irregular spheroidal nodules and in veins, in clay slate, graywacke slate, the coal formation, &c. Cubes of gigantic dimensions have been found in some of the Cornish mines; pentagonal dodecahedrons and other forms occur on the island of Elba, sometimes three or four inches in diameter. Large octahedral crystals are found at Perzberg in Sweden. Magnificent crystals have been brought from Peru; but still more brilliant and well finished crystals occur at Traversella in Piedmont. Alston Moor, Derbyshire, Cornwall, Fahlun in Sweden, Kongsberg in Norway, are well known localities. The clay at Munden, near Hanover, and the chalk at Lewes in Surry, have afforded some remarkable compound crystals. It has also been met with in the Vesuvian lavas in small irregular crystals.

At Rossie, N. Y., polished crystals variously modified occur at the lead mine in green shale; at Scoharie, ½ mile west of the court house, in single and compound crystals, often highly polished and abundant; in interesting crystals at Johnsburgh and Chester, Warren Co., N. Y.; in gneiss near Yonkers; in Orange Co. at Warwick and Deerpark; in Jefferson Co. in Champion, and near Oxbow on the banks of Vrooman lake in modified octahedrons, (fig. 3, Plate I;) in limestone at Shoreham, Vt., crystals are abundant; at Lane's mine, Monroe, Conn., in small octahedral crystals; in cubes in chlorite slate at Orange and Milford, Conn., and in mica slate at Stafford: in Massachusetts at Heath in handsome crystals: in Maine at Corinna, Peru, Waterville, and Farmington: in modified cubes at Little Brittain, Lancaster Co., Penn. Massive varieties are very abundant in the United States. They occur in Connecticut in gneiss at Colchester, Ashford, Tolland, Stafford, and Union; in Massachusetts at Hawley and Hubbardston; in Maine at Bingham, (sawmills,) Brooksville, and Jewell's Island; in New Hampshire at Unity; in New York in Franklin, Putnam, and Orange Cos., and elsewhere.

This species is of the highest importance in the arts, as it affords the greater part of the sulphate of iron and sulphuric acid of commerce, and also a considerable portion of the sulphur and alum. The sulphur and sulphate of iron, or green vitriol, are commonly obtained at one and the same process. The pyrites is usually heated in clay retorts, by which about 17 per cent. of sulphur is distilled over and collected. The ore is then thrown out into heaps and exposed to the atmosphere, and afterwards lixiviated. The solution is then collected in ditches constructed for the purpose, and crystallized. In other instances the ore is piled in heaps, after being broken in small pieces and then moistened, when decompo-

sition goes on as before. This decomposition often takes place in cabinets, me the moisture of the atmosphere; but usually only in massive varieties. In Germ lixiviated liquid is employed for the production of sulphuric acid, by evaporating and distilling it; and the residue, which is an oxyd of iron, often called colcothar, is used as a coarse red pigment.

This species is also of importance in the smelting of ores, particularly those of silver.

Pyrites sometimes contains, mechanically mingled, a minute quantity (perhaps one five thousandth part) of gold, and is then termed *auriferous pyrites.* It occurs abundantly in the gold mines of Beresoff in Siberia, and in Brazil, in detached disintegrating crystals of a dark-brown color.

The name *pyrites*, is derived from the Greek, πυρίτης, a term applied to this mineral, because, as Pliny states, "there was much fire in it," as was made apparent by friction. This term was applied to flint and some siliceous millstones, for a similar reason.

Cuban, (Breithaupt, Pogg. lix, 325, 1843.) Breithaupt's *cuban* is a sulphuret of iron and copper. It is described as occurring in cubes or massive, between bronze and brass-yellow in color, with the streak black, hardness=4, and specific gravity=4·026. The cubes have rather a distinct cubic cleavage. Breithaupt obtained, in repeated trials, 19 per cent. of copper. Fuses easily before the blowpipe, giving off fumes of sulphur, but no arsenic. It was brought from the island of Cuba.

VARIEGATED COPPER ORE. Pyrites erubescens.

Octahedral Copper-Pyrites, *M.* Variegated Copper, *J.* Purple Copper, *P.* Liver-colored Copper Ore. Buntkupfererz, *W.* and *L.* Bunter Kupferkies, *Haus.* Cuivre Pyriteux Hepatique, *H.*

Primary form, the regular octahedron. *Secondary forms:* figs. 1, 2, and 3, Pl. I. *Cleavage* octahedral in traces. *Compound crystals:* fig. 129, Pl. II. *Imperfect crystallizations:* structure granular, strongly connected.

H.=3. G.=5·003. *Lustre* metallic. *Streak* pale grayish black, and slightly shining. *Color* between copper-red and pinchbeck brown. *Fracture* small conchoidal, uneven. Brittle. It speedily tarnishes when exposed.

Composition, according to Hisinger, (Afhand. iv, 359,) R. Phillips, (Ann. Phil. 2d ser 81,) Plattner, (Pogg. xlvii, 351,) and Bodemann, (Pogg. lv, 115,)

	Ross I. Killarney Sea.	Cornwall.		White Sea.	Bristol, Conn.
Sulphur,	23·75	28·238	24·696	25·058	25·70
Copper,	61·07	56·763	63·334	63·029	62·75
Iron,	14·00	14·843	11·804	11·565	11·64
Silica,	0·50	——	0·166	——	0·04
	99·32, Ph.	99·844, Pl.	100·000, H.	99·652, Pl.	100·13, B.

Plattner supposes that there are three or more distinct compounds included under the name variegated copper ore, (Pogg. xlvii)—the first analysis belonging to one species, the second to another, and the three following to a third.

Before the blowpipe it blackens, and becomes red on cooling; at a higher temperature it fuses to a globule, attractable by the magnet. It is mostly dissolved by nitric acid.

Obs. It occurs with other copper ores in primitive and secondary rocks.

The crystalline varieties have been found only in Cornwall, and mostly in the mines of Tincroft and Dolcoath near Redruth, where it is called by the miners "horse-flesh-ore." Other foreign localities of massive varieties are at Ross Island in Killarney, in Ireland, in cupriferous shale in the Mansfield district, and in Norway, Siberia, Hessia, Silesia, and the Bannat.

Massive varieties of variegated copper are found in the United States at Mahoopeny, near Wilkesbarre, Penn., and in other parts of the same State, in a cupriferous shale, associated in small quantities with vitreous copper; also in granite at Chesterfield, Mass., also

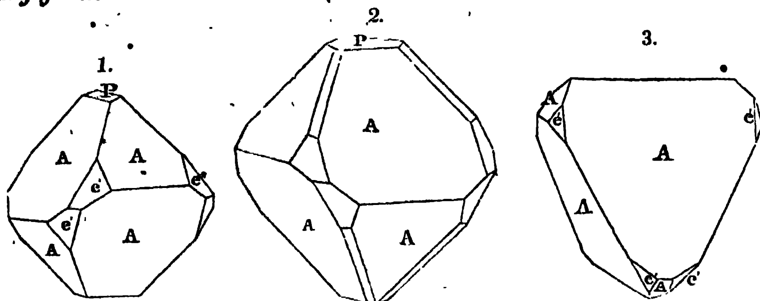
Jersey and Connecticut. At Bristol, Conn., it is abundant in granite beds con-
l in mica slate. At Cheshire, it is met with in small cubes, along with heavy spar, malachite, and vitreous copper.

This species is a valuable ore of copper. Its name alludes to its liability to tarnish, and thus receiving a reddish hue.

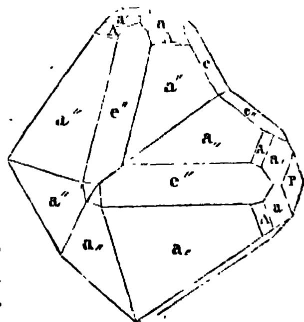
COPPER PYRITES. PYRITES PYRAMIDALIS.

Pyramidal Copper Pyrites, *M*. Octahedral Copper Pyrites, *J*. Yellow Copper Pyrites. Pyritous Copper. Yellow Copper Ore. Kupferkies, *W*. and *L*. Cuivre Pyriteux.

Primary form, a square octahedron; A : A (over a terminal edge) =109° 53′, A : A (over a basal edge) =108° 40′, Phillips. *Secondary forms:*



A : e′=140° 46′; e′ : e′ (over A)=101° 49′, over base=126° 11′; e″ : e″ (over a″)=108° 18′, a′ : a′=132° 19′, a″ : a″=100° 44′. *Cleavage* sometimes distinct, parallel with e′; parallel with P, indistinct. *Compound crystals:* 1. Composition of the *third kind*—parallel to A, producing a form resembling fig. 129, Pl. II. Very complex forms result when this composition takes place, parallel to each of the faces A. 2. Composition of the *second kind*—parallel to e. This form is represented in the annexed figure. A repetition of this composition parallel to each of the terminal edges, produces some of the most singularly complex and interesting forms in the mineral kingdom.* *Imperfect crystallizations:* globular, botryoidal, stalactitic, and other shapes—texture impalpable; granular, often impalpable—particles strongly coherent.



H.=3·5—4. G.=4·159—4·169. *Lustre* metallic. *Streak* greenish-black—a little shining. *Color* brass-yellow; subject to tarnish. Opaque. *Fracture* conchoidal, uneven. Rather sectile.

*These forms have been accurately delineated and described by Haidinger, in the third volume of Brewster's Journal, in a highly finished article on twin crystals, continued from vol. i, of the same Journal, into several of the succeeding volumes.

Composition, according to H. Rose, (Annals of Phil. 2d ser. vii, 355,) Phillips, (Annals of Phil. 2d ser. iii, 299,) Berthier, (Ann. des Mines, viii, 341,) and Thomson, (Min. i, 624,)

	Ramberg			Cornwall.
Sulphur,	35·87	34·46	36·3	34·655
Copper,	34·40	31·20	32·1	33·640
Iron,	30·47	30·80	31·5	31·535
Earthy matter,	0·27	1·10	—	0·555
	101·01, R.	97·56, P.	99·9, B.	100·385, T.

Before the blowpipe, on charcoal, it blackens, but becomes red on cooling. After a continued heat, it fuses to a globule which is magnetic. With borax it affords pure copper. Dissolves in nitric acid, excepting the sulphur, forming a green solution. A drop of liquid ammonia changes it to a deep blue.

Obs. Copper pyrites is the principal ore of copper at the Cornish mines. It is there associated with tin, variegated copper, vitreous copper, galena, gray copper, and blende. The copper beds of Fahlun in Sweden, are composed principally of this ore, which occurs in large masses, surrounded by a coating of serpentine, and imbedded in gneiss. At Rammelsberg, near Goslar in the Hartz, it forms a bed in graywacke slate, and is associated with iron pyrites, galena, blende, and minute portions of silver and gold. The Kurprinz mine at Freiberg, affords well defined crystals. It occurs also in the Bannat, Hungary, Thuringia, &c.

In the United States it has been found in several places, but nowhere in sufficient abundance to be worked. It occurs at the Southampton Lead Mines, Mass., at Turner's falls on the Connecticut, near Deerfield, and at Hatfield and Sterling, Mass.: at Strafford and Shrewsbury in Vermont, with magnetic pyrites: in New Hampshire, at Franconia, in gneiss; at Unity, on the estate of Jas. Neal; at Warren, on Davis's farm; at Eaton, two miles northeast of Atkins's tavern; at Lyme, east of east village; at Haverhill and elsewhere: in Maine, at the Lubec lead mines, and at Dexter: in New York, at the Ancram lead mine; five miles from Rossie, beyond DeLong's mills; at the Rossie lead mine in crystals; and in crystals and massive at the mine near Wurtzborough, Sullivan Co.: in Virginia, at the Phenix copper mines, Fauquier Co., and the Walton gold mine, Luzerne Co.: in the Catoctin Mts., Maryland, and between Newmarket and Taneytown.

Cornwall has hitherto been one of the most important sources of copper. The following remarks on the mines in that region, are cited from Allan's Mineralogy, p. 261: "In the year ending 30th June, 1822, 104,522 tons of copper ore were raised in Cornwall, which sold for £663,085, and yielded 9140 tons of pure copper. In 1826, 117,308 tons were raised, which sold for £788,971, and yielded 9026 tons of copper; and in 1832, 137,357 tons of copper ore were raised, which sold for £825,612, and produced 11,947 tons of metallic copper. The whole produce of Great Britain and Ireland amounts to about 14,500 tons of copper, five sixths of which thus appear to be raised from the mines of Cornwall alone, and by much the larger portion, no doubt, in the form of copper pyrites. The enormous expense of fuel in that district, and the difficulty thereby occasioned of keeping the more extensive workings free of water, is however a most serious drawback on the profits of Cornish mining.

"Though copper pyrites occurs in vast profusion, it is by no means a rich ore; what is picked for sale at Redruth rarely yielding 12, generally only 7 or 8, and occasionally so little as 3 or 4 per cent. of metal. In the latter case, such poverty of ore is only made up by its facility of transport, the moderate expense of fuel, or the convenience of smelting. Its richness may in general be judged of by the color; if of a fine yellow hue, and yielding readily to the hammer, it may be considered a good ore; but if hard and pale-yellow, it is assuredly a poor one, being mixed with iron pyrites."

Copper pyrites is readily distinguished from iron pyrites, which it somewhat resembles, by its inferior hardness; it may be cut by the knife, while iron pyrites will strike fire with the steel. The effects of nitric acid are also different. It differs from gold in being brittle, on account of which it cannot be cut off in slices, like the latter metal.

ORDER X.—GALINEA.

TIN PYRITES. Cyprites cubicus.

Hexahedral Dystome-Glance, *M.* Sulphuret of Tin, *P.* Cupreous Sulphuret of Tin, *Thom.* Bell Metal Ore. Zinnkies, *W.* Etain Sulfuré, *H.*

Primary form, the cube.. Occurs commonly massive—structure granular, particles strongly coherent.

H.=4. G.=4·3—4·4. *Lustre* metallic. *Streak* black. *Color* steel-gray when pure; often yellowish from the presence of copper pyrites. Opaque. *Fracture* uneven. Brittle.

Composition, according to Klaproth, (Beit. ii, 257, and v, 228,)

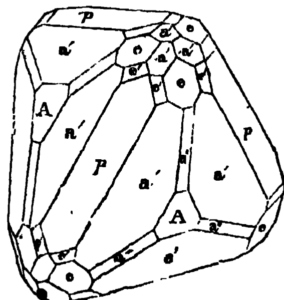
Sulphur,	25	30·5
Tin,	34	26·5
Copper,	36	30·0
Iron,	2=97	12·0=99

Before the blowpipe sulphur is expelled, and afterwards a black scoriaceous globule is obtained. The charcoal is covered with the oxyd of tin. It is soluble in nitro-muriatic acid, with the exception of a residue of sulphur.

Obs. This species has been observed only in Cornwall, and principally at Hull Rock, in the parish of St. Agnes, where it forms a considerable vein, and is accompanied by iron pyrites, blende, and other minerals. It frequently has the appearance of bronze, or bell metal, and hence the name *bell metal ore.*

GRAY COPPER ORE. Cyprites tetrahedrus.

Tetrahedral Dystome-Glance, *M.* and *J.* Gray Copper, Fahlerz, *P.* Schwarzerz, *W.* Kupferfahlerz, Schwarzgiltigerz, *Haus.* Cuivre Gris, *H.*



Primary form, the octahedron. *Secondary forms:* crystals hemihedrally modified; figs. 7, 16, 30, 32, 34, 35, 36. *Cleavage* in traces parallel to the faces of the octahedron. *Compound crystals:* composition parallel to a face of the octahedron. *Imperfect crystallizations:* structure granular—particles of various sizes, often impalpable, strongly connected.

H.=3—4. G.=4·798—5·104, Haidinger. *Lustre* metallic. *Streak* sometimes inclined to brown, but generally the same as the color. *Color* between steel-gray and iron-black. Opaque. *Fracture* subconchoidal, uneven. Rather brittle.

Composition, according to H. Rose, (Pogg. xv, 576,)

	Alsace.	Gersdorf.	Kapnik.	Clausthal.
Sulphur,	26·83	26·33	25·77	24·73
Copper,	40·60	38·63	37·98	34·48
Antimony,	12·46	16·52	23·94	28·24
Arsenic,	10·19	7·21	2·88	—
Iron,	4·66	4·89	0·86	2·27
Zinc,	3·69	2·76	7·29	5·55
Silver,	0·60	2·37	0·62	4·97
Silica,	0·41	—	—	—
	99·44	98·71	99·34	100·24

A variety from Guadalcanal in Spain, contains from one to ten per cent. of platinum; another from Hohenstein, a little gold; and another from Valdi Castello in Tuscany, 2·70 per cent. of mercury. Their comportment before the blowpipe is somewhat various. They all give off fumes of antimony and arsenic, finally melt, and after roasting, afford a globule of copper. When pulverized, they dissolve with a little residue in nitric acid. The solution has a brownish-green color.

Obs. The Cornish mines, near St. Austle, afford large tetrahedral crystals; their surfaces are commonly rough and dull. More brilliant and highly modified crystallizations occur at Andreasberg in the Hartz, Kremnitz in Hungary, Freiberg in Saxony, Kapnik in Transylvania, and Dillenberg in Nassau. Those belonging to the *Fahlerz* (gray ore) of Werner, have a steel-gray color. The *Schwarzerz* is nearly iron-black. This variety occurs principally at the old mine of Schwatz in the Tyrol, and at Kapnik in Transylvania; also at Clausthal in the Hartz, where it is imbedded in red manganese.

It is associated usually with copper pyrites, and is worked as an ore of copper.

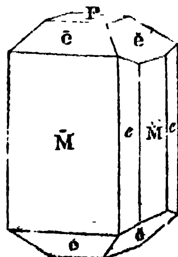
Silberfahlerz. The silberfahlerz of the Germans, or *argentiferous gray copper ore*, is a gray copper ore in which part of the copper is replaced by silver. It occurs in tetrahedrons of a light steel-gray color; H.=3—3·5. G.=4·8—5·1. H. Rose obtained for the composition of two specimens from different localities,

	Furstenberg.	Freiberg.
Sulphur,	23·52	21·17
Antimony,	26·63	24·63
Silver,	17·71	31·29
Copper,	25·53	14·81
Iron,	3·72	5·98
Zinc,	3·10=99·91	0·99=98·87

Fuses very easily before the blowpipe, giving off fumes of antimony. Yields silver with soda and borax.

BOURNONITE. Cypritès rectangulus.

Di-prismatic Dystome-Glance, *M.* Triple Sulphuret. Endellionite, *Bournon.* Schwarz-Spiessglanzerz, *W.* Bleifahlerz, Spiessglanz bleierz, *Haus.* Bournonit, *L.* Radelerz. Antimoine Sulfuré plombo-cuprifère, *H.*



Primary form, a right rectangular prism. *Secondary form*: P : ē=133° 34′, P : ĕ=136° 50′, M̄ : e=138° 15½′, M̆ : e=131° 45½′, e : e (over M̄)=96° 31′. *Cleavage* parallel with M̄ and M̆, and P; M̄ the most distinct: also in traces parallel with e. *Compound crystals*: composition of the second kind, parallel to ĕ; cruciform crystals often occur, resulting from this kind of composition. These crystals cross at angles of 93° 40′, and 86° 20′, as necessarily follows from the inclination of P on ĕ.

Imperfect crystallizations: structure granular, particles strongly connected.

H.=2·5—3. G.=5·766, Hatchett. *Lustre* metallic. *Streak* and *color* steel-gray, inclining to blackish lead-gray, or iron-black. Opaque. *Fracture* conchoidal, or uneven. Brittle.

Composition, according to H. Rose, (Pogg. xv, 573,)

	Crystals from Pfaffenberg
Sulphur,	20 31
Antimony,	26 28
Lead,	40 84
Copper,	12 65=100 08

It decrepitates in the blowpipe flame and gives off white fumes of sulphur. Ultimately, it fuses to a black globule. In a strong heat, the charcoal is covered with oxyd of lead. It readily dissolves in nitric acid.

OBS. The finest crystallizations of this species occur in the mines of Neudorf in the Hartz, where they occasionally exceed an inch in diameter. It accompanies quartz, gray copper ore, and phosphorescent blende, at Kapnik in Transylvania, in flattened crystals; at Servos in Piedmont, it is associated with pearl spar and quartz. Other localities are at Braunsdorf and Gersdorf in Saxony, Clausthal and Andreasberg in the Hartz, &c.; also Endellion, near Redruth in Cornwall, where it was first found, and whence it was called *Endellionite*, by Count Bournon. It has since been named in honor of this distinguished mineralogist.

ANTIMONIAL COPPER GLANCE.

Prismatoidal Copper Glance, *Mohs*.

Massive with a rhombic cleavage.

H.=3. G.=5 7—5·8. Color blackish lead-gray. Fracture conchoidal to uneven. Brittle.

Composition, according to Schrotter, Sulphur 28·602, antimony 16 617, arsenic 6 036, lead 29·902, copper 17·352, iron 1·404, water 2·307=102·250.

OBS. Occurs at St. Gertraud in Carinthia.

TENNANTITE. CYPRITES DODECAHEDRUS.

Dodecahedral Dystome Glance, *M.* Quart. Journ. vii, 95. Graukupfererz.

Primary form, the rhombic dodecahedron. *Secondary forms:* figs. 5, 6, 32, 36, Pl. I. *Cleavage* parallel with the faces of the primary, imperfect. Has not been observed massive.

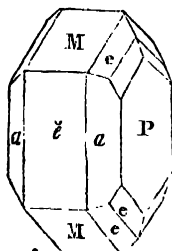
H.=3·5—4. G.=4·375—4·491. *Lustre* metallic. *Streak* reddish-gray. *Color* blackish lead-gray. *Fracture* uneven.

Composition, according to Phillips, (Phil. Mag. x, 157,) Copper 45 32, arsenic 11·84, iron 9·26, sulphur 28·74, silica 5. Before the blowpipe it decrepitates slightly, burns with a blue flame, emits copious arsenical fumes having an alliaceous odor, and finally fuses to a black scoria, which acts upon the magnet.

OBS. This species has only been observed in the Cornish mines, particularly near Redruth and St. Day. It commonly occurs in very splendent crystals investing other ores of copper.

VITREOUS COPPER. CYPRITES RHOMBICUS.

Prismatic Copper-Glance, *M.* Sulphuret of Copper. Disulphuret of Copper, *M.* Glance Copper. Kupferglas, *W.* Kupferglanz, *Haus.* and *L.* Cuivre-Sulfuré, *H.*



Primary form, a right rhombic prism; M : M =119° 35′. *Secondary form*: ĕ : *a*=117° 10′. M : e=152° 41′, M : e′=122° 44′. *Cleavage* indistinct parallel to M. *Compound crystals*: stellated forms similar to those of Arragonite; very frequent. *Imperfect crystallizations*: structure granular, particles of various sizes, usually small and often impalpable.

H.=2·5—3. G.=5·5—5·8; 5·7022, Thomson. *Lustre* metallic. *Streak* and *color* blackish lead-gray; often tarnished blue or green; streak sometimes shining. *Fracture* conchoidal. Sectile.

Composition, according to Klaproth (Beit. ii, 276, and iv, 37) and Thomson, (Min. i, 599.)

			Cornwall,
Sulphur,	18·50	22·0	20·62
Copper,	78·50	76·5	77·16
Iron,	2·25	0·5	1·45
Silica,	0·75=100, K.	——=99, K.	——=99·23, T.

In the oxydizing flame of the blowpipe it melts, gives out fumes of sulphur, and emits glowing drops with a noise, coloring the flame at the same time blue. In the reducing flame it becomes covered with a coating and does not melt. If the sulphur is driven off, a globule of copper remains. In heated nitric acid the copper is dissolved, and the solution assumes a green color; the sulphur is precipitated.

Obs. Cornwall affords splendid crystals of this species, where it occurs in veins and beds with other ores of copper. Some of the Cornish collections contain elegant suites of this beautiful mineral. The compact and massive varieties occur in Siberia, Hesse, Saxony, the Bannat, &c.

In the United States, compact varieties occur in the red sandstone formation at Simsbury and Cheshire, Conn.; also at Schuyler's mines, N. Y. A fine vein has lately been discovered at Bristol, Conn. In Virginia, it occurs in the U. S. copper mine district, Blue Ridge, Orange Co. Between New Market and Taneytown, Maryland, east of the Monocacey, associated with copper pyrites.

The argent en epi, or Cuivre spiciforme of Haüy, which is merely vegetable matter impregnated with this ore, occurs at Mahoopeny, Penn.

BLUE COPPER. CYPRITES LIVIDUS.

Kupferindig.

Massive; in spheroidal forms with a crystalline surface.

G.=3·8—3·82. *Lustre* resinous, faint. *Streak* lead-gray, shining. *Color* indigo-blue or darker. Opaque. Sectile.

Composition, according to Walchner, Copper 64·77, sulphur 32·64, lead 1·05, iron 0·46. Before the blowpipe it burns, before becoming red hot, with a blue flame, and fuses to a globule, which is strongly agitated and emits sparks; finally it yields a button of copper.

Obs. Occurs with other copper ores at the Hausbade mine near Badenweiler; and according to Covelli, at Vesuvius.

SELENID OF COPPER. CYPRITES SELENICUS.

Massive. *Lustre* metallic. *Color* silver-white. *Streak* shining.

Composition, according to Berzelius, Selenium 40, copper 64.
Before the blowpipe it gives off the odor of selenium and fuses to a gray bead. With soda it is reduced.
OBS. Occurs at Skrikerum in Sweden.

ANTIMONIAL COPPER.

Sulphuret of Copper and Antimony, *H. Rose*, Pogg. xxxv, 357. Kupferantimonglanz.

Occurs in small aggregated prisms, which, according to G. Rose, are right rhombic, with their edges deeply truncated.
H.=3—4. G. at least 4·474. *Lustre* metallic. *Streak* black. *Color* between lead-gray and iron-gray. Opaque. *Fracture* conchoidal.

Composition, according to H. Rose, Copper 24·46, iron 1·39, antimony 46·81, lead 0·56, sulphur 26·34=99·56. The iron is supposed to exist in it, in the state of pyritous copper, and the lead, in that of feather ore. It is always covered with a coat of copper pyrites.
OBS. It occurs in nests in the mine of gray antimony, at Wolfsberg in the Hartz.

SELENSILVER. LUNITES SELENICUS.

Primary form, the cube. *Cleavage* cubic, perfect.
H.=2·5. G.=8·0. *Lustre* metallic. *Color* and *streak* iron-black.

Composition, according to G. Rose, (Pogg. xiv, 471,) Silver 65·56, lead 4·91, selenium 29·53=100.
Before the blowpipe on charcoal it melts easily in the outer flame; in the inner with some intumescence. With soda and borax it yields a bead of silver.
OBS. Occurs at Tilkerode in the Hartz.
According to Del Rio another selenid of silver occurs at Tasco in Mexico, crystallized in hexagonal tables.

EUCAIRITE. LUNITES BERZELII.

Seleniuret of Silver and Copper, *P.* Argentiferous Seleniet of Copper. Eukairite, *Berzelius* and *L.* Selenkupfersilber *of the Germans*. Cuivre Sélénié Argental, *H.*

Massive; in black metallic films, staining the calcareous spar in which it is contained.
Soft. *Lustre* metallic. *Streak* shining. *Color* between silver-white and lead-gray.

Composition, according to Berzelius, (Afhand., vi, 42,) Selenium 26, copper 23·05, silver 38·93, foreign earthy matter 8·90=96·88.
Before the blowpipe it gives out copious fumes of selenium, attended with the odor of horse-radish; and on charcoal, fuses readily to a gray metallic globule, which colors borax green, leaving a bead of selenid of silver. It dissolves in boiling nitric acid.
OBS. It has been found only in small quantities in the Skrikerum copper mine in Smaland, Sweden, in a serpentine kind of rock, imbedded in calcareous spar. It was discovered and analyzed by Berzelius, and named from ευ and καιρος, *opportunely*, because the mineral was found soon after the discovery of the metal selenium.

STROMEYERITE. Lunites cupriferus.

Argentiferous Copper-Glance, *J.* Sulpho-Cuprite of Silver, *Thom.* Argentiferous Sulphuret of Copper. Cupreous Sulphuret of Silver. Sulphuret of Silver and Copper. Silber-kupferglanz *of the Germans.* Cuivre Sulfuré Argentifère.

Massive; impalpable.

H.=3—4. G.=4·258. *Lustre* metallic. *Streak* shining. *Color* steel-gray. *Fracture* subconchoidal. Sectile.

Composition, according to Stromeyer, (Gilbert's Annalen, liv, 114,) Sulphur 15·782, silver 52·272, copper 30·478, iron 0·333=98·865. Easily fusible. The blue solution, obtained with nitric acid, affords indications of copper, when a plate of iron is dipped into it, and also precipitates silver upon an immersed copper plate.

Obs. This species is of rare occurrence. It is found associated with copper pyrites at Schlangenberg, near Colivan in Siberia. A variety has been observed at Combavalla in Peru, which contains some iron. It was first described and recognized as a distinct species by Stromeyer.

VITREOUS SILVER. Lunites dodecahedrus.

Hexahedral Silver Glance, *M.* and *J.* Sulphuret of Silver, Vitreous Silver, *P.* Glaserz, *Haus.* Silberglanz, *L.* Argent Sulfuré, *H.*

Primary form, the rhombic dodecahedron. *Secondary forms:* figures 1—9, inclusive, Plate I, also 14, 15, 16. *Cleavage* dodecahedral in traces. *Imperfect crystallizations:* reticulated, arborescent, and filiform; also amorphous.

H.=2—2·5. G.=7·196—7·365. *Lustre* metallic. *Streak* and *color* blackish lead gray; streak shining. Opaque. *Fracture* small subconchoidal, uneven.

Composition, according to Klaproth, (Beit. i, 158,) Silver 85, and sulphur 15=100. A fragment before the blowpipe intumesces, and soon affords a globule of silver. It is soluble in dilute nitric acid, and when isolated and rubbed, acquires resinous electricity.

Obs. This important ore of silver occurs in Europe, principally at Annaberg, Joachimstahl, and other mines of the Erzgebirge, at Schemnitz and Kremnitz in Hungary, and at Freiberg. At the last place it accompanies other silver ores; in veins traversing gneiss. The silver of Mexico is obtained principally from this ore.

A mass of sulphuret of silver is stated by Troost to have been found in Sparta, Tennessee; it also occurs with native silver and copper in Northern Michigan. A silver ore, not yet analyzed, occurs, according to Jackson, with gray antimony, at Cornish, N. H.

TELLURIC SILVER. Lunites telluriferus.

Bitelluret of Silver, *Thom.* Tellursilber *of the Germans.*

In coarse-grained masses.

H.=2—2·5. G.=8·31—8·33. *Lustre* metallic. *Color* between lead-gray and steel-gray.

Composition, according to G. Rose, (Pogg. xviii, 64,) Silver 62·32, tellurium 36·89, and iron 0·50=99·71. A variety from Nagyag has been described by W. Petz, (Pogg. lvii, 467,) consisting of Silver 46·76, gold 18·26, tellurium 34·98. The first variety has G.=8·31—8·45; the second, G.=8·72—8·83.

Before the blowpipe, on charcoal, it fuses to a black globule, which on cooling, after the action of the reducing flame, presents points or dendrites of silver on its surface. When

heated in a glass tube it melts and gives a yellow color to the glass. Fused with carbonate of soda a globule of pure silver is obtained.

OBS. It occurs in the new mine of Savodinski, about forty wersts from the rich silver mine of Siränowski, on the river Buchthorma in Siberia, where it is found in a talcose rock, containing small quantities of iron pyrites, black blende, and copper pyrites. Specimens in the museum of Barnaul, on the Ob, where this mineral was first observed, are a cubic foot in size. It was first described and analyzed by G. Rose.

POLYBASITE. LUNITES RHOMBOHEDRUS.

Rhombohedral Melane-Glance, *M.* Eugenglanz.

Primary form, a rhombohedron. Usually in short tabular hexagonal prisms. Terminal planes striated, parallel to the alternate terminal edges. *Cleavage* not observable. Also massive.

H.=2—3. G.=6·214. *Lustre* metallic. *Streak* black. *Color* iron-black. Opaque. *Fracture* uneven.

Composition, according to H. Rose, (Pogg. xv, 575,)

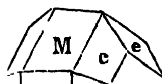
	Durango.
Sulphur,	17·04
Silver,	64·29
Antimony,	5·09
Arsenic,	3·74
Copper,	9·93
Iron,	0·06=100·15

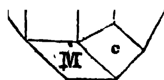
OBS. It occurs in the mine at Guanaxuato and Gaudalupe y Calvo in Mexico; also at Guansamez in Durango, with copper pyrites and calcareous spar.

The name Polybasite is derived from πολυς, *much*, and βασις, *base*, in allusion to the large amount of the base sulphuret of silver, as compared with the acids, the sulphurets of arsenic and antimony.

BRITTLE SILVER ORE. LUNITES RHOMBICUS.

Prismatic Melane-Glance, *M.* Brittle Silver Glance. Black Silver. Brittle Sulphuret of Silver. Trisulpho-Antimoniate of Silver. Sprödglaserz, *W.* Sprödglanzerz, *Haus.* Argent Noir, Argent Antimonié Sulphuré Noir, *H.* Argent Sulphuré Fragile.





Primary form, a right rhombic prism; M : M =115° 39′, M : e=142° 10′, e : e=130° 16′ and 104° 19′, a : a (over ĕ)=107° 29′, P : a=126° 6½′. *Cleavage* imperfect and interrupted, parallel to M and ĕ. *Compound crystals:* composition of the *first kind*, producing forms similar to those of white lead ore and Arragonite; very frequent. *Imperfect crystallizations:* structure granular—particles strongly coherent.

H.=2—2·5. G.=6·269, specimen from Przibram. *Lustre* metallic. *Streak* and *Color* iron-black. *Fracture* uneven. Sectile.

Composition, according to Rose, (Pogg. xv, 475,) Sulphur 16·42, antimony 14·68, silver 68·54, copper 0·64=100·28. Before the blowpipe it fuses and gives out fumes of sulphur and antimony, and is reduced to a dark colored metallic globule, which may be further reduced by the addition of soda or silica. Soluble in dilute nitric acid.

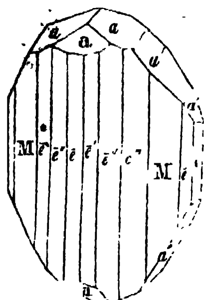
Obs. It occurs in veins with other silver ores at Freiberg, Schneeberg, and Johanngeorgenstadt in Saxony, at Przibram and Ratieborzitz in Bohemia, at Schemnitz and Kremnitz in Hungary, at Andreasberg in the Hartz, at Zacatecas in Mexico, and in Peru.

The *schwarzgültigerz*, of Werner, includes the compact varieties of this species, and his *weiss-gultigerz* is merely a mechanical mixture of brittle silver, galena, and gray antimony.

It is a valuable ore of silver.

ANTIMONIAL SULPHURET OF SILVER. Lunites peritomus.

Peritomous Antimony-Glance, *M.* Sulphuret of Silver and Antimony, *P.* Schwefel Schilfglaserz, *Freisleben.* Silber und Antimon. Argent Sulfure Antimonifère et Cuprifère, *Levy.*



Primary form, a right rhombic prism; M : M=100° 8′. *Secondary form:* a : a=130° 8′, a″ : a″=122° 15′, ĕ : a″=118° 53′, M : ĕ′=146° 30′, M : ĕ″=160° 30′, M : ĕ‴=170° 10′. M, longitudinally striated. *Cleavage* perfect, parallel with M.

H.=2—2·5. G.=5·5—6·2; 6·194, Hausmann. *Lustre* metallic. *Color* and *streak* light steel-gray, inclining to silver-white, also blackish lead-gray. Yields easily to the knife, and is rather brittle. *Fracture* conchoidal—uneven.

Composition, according to Wöhler, (Pogg. xlvi, 157, 1839,)

Silver,	22·18	23·78
Lead,	30·00	30·08
Antimony,	27·72	27·05
Sulphur,	18·77	18·72
Iron,	0·11	——
Copper,	1·22=100·00	——=99·60

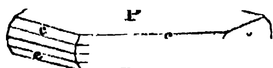
Before the blowpipe it emits copious white vapors and a slight sulphureous odor, after which, a white metallic globule remains.

Obs. Occurs with vitreous silver, spathic iron, and galena, in the Himmelsfürst mine, at Freiberg in Saxony, and Kapnik in Transylvania.

An antimonial sulphuret of silver is said to occur with native silver and native copper at the copper mines in Michigan.

STERNBERGITE. Lunites foliaceus.

Haidinger, Edin. Phil. Trans. xi, 1, and Brewster's Journal, vii, 242.



Primary form, a right rhombic prism; M : M=119° 30′. *Secondary form:* M : ĕ =120° 15′, c : e=118°. *Cleavage:* basal highly eminent. Commonly in implanted crystals, forming rose-like aggregations. The crystals are sometimes compound.

H.=1—1·5. G.=4·215. *Lustre* of P, highly metallic. *Streak* black. *Color* pinchbeck-brown, with occasionally a violet-blue tarnish on e. Opaque. Thin laminæ flexible; may be smoothed down by the nail when bent, and in this respect resembles tin-foil. Very sectile. Leaves traces on paper like plumbago, which may be removed by caoutchouc.

Composition, according to Prof. Zippe, of Prague, (Pogg. xxvii, 690,) Silver 33·2, iron 36, and sulphur 30=99·2.

Heated in a glass tube it gives off a sulphurous odor, loses its lustre, and becomes dark-gray and friable. On charcoal, before the blowpipe, it burns with a blue flame, and melts to a globule which is generally hollow, has a crystalline surface, and is covered with metallic silver. This globule acts on the magnetic needle, and exhibits the properties of sulphuret of iron. With borax, a globule of silver may be obtained.

Obs. It occurs with ores of silver, particularly the red and brittle silver ores, at Joachimstahl in Bohemia. It was first noticed by Haidinger in a specimen in the public collection at Prague, of which Count Caspar Sternberg is the patron and supporter, and named by him in honor of this talented nobleman.

FLEXIBLE SILVER ORE. Lunites rhomboideus.

Ferro-Sulphuret of Silver. Argent Sulfuré Flexible, *Bournon*.

Occurs in small tabular crystals, whose primary form, according to Brooke, is a right rhomboidal prism; M : T=125°. *Cleavage* highly perfect in one direction. Also massive.

Very soft, yields readily to the knife. *Lustre* metallic. *Streak* shining. *Color* externally nearly black. Opaque. Flexible in thin laminæ.

Consists, according to Wollaston, of silver, sulphur, and a little iron.

Obs. This rare species has been found in small quantities at Himmelsfürst in Saxony, and in Hungary.

XANTHOKON.

Breithaupt, J. f. prakt. Chem. xx, 67.

In reniform masses, with the interior consisting of minute crystals.

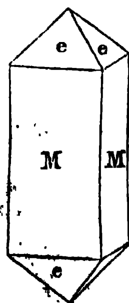
H.=2. G.=4·112—4·159. *Color* dull-red to clove-brown; crystals orange-yellow on the edges by transmitted light. *Streak-powder* yellow.

Contains 59·1 per cent. of silver; the rest is arsenic and sulphur.

Obs. Occurs with brittle silver ore at the Himmelsfürst mine, in the neighborhood of Freiberg. It was named by Breithaupt, in allusion to its yellow powder, from ξανθος, *yellow*, and κονις, *powder*.

GRAY ANTIMONY. Lycites diatomus.

Prismatoidal Antimony-Glance, *M.* Sulphuret of Antimony, *P.* Sesquisulphid of Antimony, *Thom.* Grauspiessglaserz, *W.* Grauspiessglanzerz, *Haus.* Antimonglanz. Antimoine Sulfuré, *H.* Stibium, Στιμμι. Πλατυόφθαλμον. Leo Ruber. Plumbum Nigrum, *Vetr.* Lupus Metallorum. (*Alchem.*)



Primary form, a right rhombic prism; M : M=90° 45′. *Secondary form*: M : e=145° 29′, e : e=109° 16′, and 108° 10′. Lateral planes deeply striated longitudinally. *Cleavage* highly perfect, parallel with the shorter diagonal. *Imperfect crystallizations*: columnar, particles of various sizes, usually thin; granular—impalpable.

H.=2. G.=4·516, Haüy; 4·62, Mohs. *Lustre* metallic. *Streak* and *color* lead-gray, inclining to steel-gray: subject to tarnish. *Fracture* small subconchoidal. Sectile. Thin laminæ a little flexible.

Composition, according to Davy, Bergman, (Chem. Opus. ii, 167,) and Thomson, (Min. i, 86,)

Antimony,	74·06	74	73·77
Sulphur,	25·94=100, D.	26=100, B.	26·23=100, T.

Fuses readily in the flame of a candle; before the blowpipe it is absorbed by the charcoal, emitting white fumes and a strong sulphureous odor.

Obs. Gray antimony occurs with spathic iron in beds, but generally in veins. It is often associated with blende, heavy spar, and quartz.

It is met with in veins at Wolfsberg, in the county of Stollberg in the Hartz, and at Poesing, near Presburg in Hungary. Its most celebrated localities, however, are Felsobanya, Schemnitz, and Kremnitz in Hungary, where it often occurs in diverging prisms, several inches long, accompanied by crystals of heavy spar and other mineral species. In Dumfriesshire it occurs fibrous and laminated; in Cornwall massive; and compact at Magurka in Hungary.

In the United States, it occurs at Carmel, Penobscot Co., Me., and at Cornish and Lyme, N. H.; also at "Soldier's Delight," Md.

This ore affords nearly all the antimony of commerce. The crude antimony of the shops is obtained by simple fusion, which separates the accompanying rock. From this product, most of the pharmaceutical preparations of antimony are made, and the pure metal extracted. This ore was employed by the ancients for coloring the hair, eyebrows, eyelashes, and edges of the lids; and as this last application was intended to increase the apparent size of the eye, they called the ore πλατυόφθαλμον, from πλατυς, *broad*, and οφθαλμος, *eye*. According to Dioscorides, it was prepared for this purpose by enclosing it in a lump of dough, and then burning it in the coals till reduced to a cinder. It was then extinguished with milk and wine, and again placed upon coals and blown till ignition; after which the heat was discontinued, lest, as Pliny says, "plumbum fiat," *it become lead*. From this we may infer, that the metal antimony was occasionally seen by the ancients, though not recognized by them as distinct from lead. (Moore's An. Min., p. 52.)

BERTHIERITE. Lycites Berthieri.

Haidingerite *of Berthier*. Berthierit, *Poggendorf*.

In elongated prisms or massive; a longitudinal cleavage rather distinct.

Lustre metallic, less splendent than gray antimony. *Color* dark steel-gray, inclining to pinchbeck-brown; surface often covered with iridescent spots.

Composition, according to Berthier, (Ann. de Ch. et de Ph. xxxv, 351,) Sulphuret of antimony 73·22, sulphuret of iron 26·78.

Fuses readily before the blowpipe, gives out fumes of antimony, and forms a black slag which acts on the magnet. Dissolves readily in muriatic acid, giving out sulphuretted hydrogen.

Obs. It occurs at Chazelles in Auvergne, associated with quartz, calcareous spar, and iron pyrites. It yields antimony of so inferior quality, that manufacturers cannot use it. It was first recognized and analyzed by Berthier.

Berthier has lately described two other ores of antimony, (Memoires par Berthier, ii, 273,) which have the following characters:

The first has a fibrous or feathery texture, cross fracture granular, and almost dull. The color is grayish-blue, but less blue and having less lustre than gray antimony. *Composition*, Sulphuret of antimony 84·3, and sulphuret of iron 15·7. It occurs in the mine of Martouret near Chazelle.

The other has an iron-gray color, or approaching bronze, and a granular and fibrous structure. *Composition*, Sulphuret of antimony 80·6, and sulphuret of iron 19·4. It is found at Anglar in the department of La Creuse.

GEOCRONITE. LYCITES SVANBERGII.

Geokronit, *Svanberg*, K. V. Ac. H. 1839, p. 184. Kilbrickenite, *Apjohn*.

Massive, with imperfect cleavage in one direction. Also granular or earthy. H.=2—2·5. G.=5·88, Geocronite; 6·407, Kilbrickenite. *Lustre* metallic. *Streak* and *color* light lead-gray—grayish-blue. *Fracture* uneven.

Composition, according to Svanberg, Sauvage, and Apjohn,

	Sala.	Gallicia.	Kilbricken.
Lead,	66·452	64·89	68·87
Iron,	0·417	——	0·38
Copper,	1·514	1·60	——
Zinc,	0·111	——	——
Antimony,	9·576	16·00	14·39
Arsenic,	4·695	——	——
Sulphur,	16·262=99·027, Sv.	16·90=99·39, Sau.	16·36=100, Ap.

The ore from Gallicia, analyzed by Sauvage, and the Kilbrickenite of Apjohn, appear to belong to this species. In that from Sala, part of the antimony is replaced by arsenic.

Fuses readily before the blowpipe, gives off fumes of antimony, and colors the charcoal around, yellow.

OBS. Geocronite comes from the silver mines of Sala, at Torgschakts, Sweden. The ore analyzed by Sauvage occurs in Gallicia, at Meredo in Spain, in nodules in galena; it crumbles easily and soils the fingers. The Kilbrickenite is from Kilbricken, Clare Co., Ireland. The name geocronite is derived from γη, *earth*, and χρονος, *Saturn*, the alchemistic name for lead.

ZINKENITE. LYCITES ZINKENI.

G. Rose, Pogg. vii. Brewster's Journal, vi, 17.

Primary form, a hexagonal prism. *Secondary form:* the primary terminated by a low hexagonal pyramid. P : e=102° 42′. Lateral faces longitudinally striated. G. Rose found, in some instances, the interfacial angle M : M equal to 120° 39′, and hence conjectures, that the primary is a rhombic prism of this angle, and that the observed crystals are compound forms similar to fig. 3 or 6, Pl. IV. The crystals are usually in groups, sometimes forming fibrous and massive varieties. *Cleavage* not observable.

H.=3—3·5. G.=5·303. *Lustre* metallic. *Streak* and *color* steel-gray. Opaque. *Fracture* uneven.

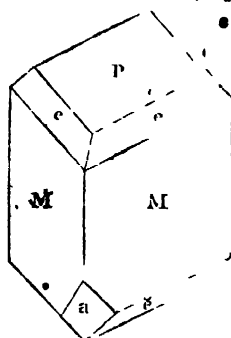
Composition, according to H. Rose, (Pogg. viii, 99,) Sulphur 22·58, lead 31·84, copper 0·42, antimony 44·39=99·23. Heated alone on charcoal it decrepitates briskly, and fuses as readily as gray antimony, affording small metallic globules, which are soon volatilized, and the charcoal is covered with a white coating of oxyd of lead. With carbonate of soda it yields globules of metallic lead.

OBS. It occurs in the antimony mine of Wolfsberg in the Hartz. Its groups of columnar crystals occur on a massive variety of the same species in quartz. These crystals sometimes exceed half an inch in length, and have a breadth of two or three lines; but frequently they are extremely thin and form fibrous masses. It was named in compliment to Mr. Zinken, the director of the Anhalt mines, by Dr. G. Rose, to whom we are indebted for the first description of it.

It much resembles gray antimony and Bournonite, but may be distinguished by its superior hardness and specific gravity.

PLAGIONITE. LYCITES OBLIQUUS.

G Rose, Pogg. xxviii 121, 1833 Hemiprismatic Dystome-Glance, M



Primary form, an oblique rhombic prism; P : M=138° 52′, M : M=120° 49′. *Secondary form*: P : ă (adjacent)=107° 32′, P : ĕ= 131° 20′, P : ê=149°, e : ĕ=142° 03′, ĕ′ : ĕ′= 131° 30′, Rose. The plane P shining and smooth; others striated. *Cleavage* lateral, perfect, but seldom affording smooth surfaces. Also massive.

H.=2·5. G.=5·4. *Lustre* metallic. *Color* blackish lead-gray. Opaque. Brittle.

Composition, according to H. Rose (Pogg xxviii, 428) and Kudernatsch, (Pogg. xxxvii, 588.)

Lead,	40·52	40·98
Antimony,	37·94	37·53
Sulphur,	21·53=99·99, R.	21·49=100·00, K.

Before the blowpipe it decrepitates and fuses easily, affording fumes of sulphur and oxyd of antimony, and coating the charcoal with oxyd of lead.

Obs. Occurs at Wolfsberg in geodes of crystals in massive plagionite or crystallized on quartz, and was discovered by Zinken It was named by Rose, in allusion to its oblique form of crystallization, from πλαγιος, *oblique*.

JAMESONITE. LYCITES ACROTOMUS

Axotomous Antimony Glance, M. Bleischimmer.

Primary form, a right rhombic prism; M : M=101° 20′ and 78° 40′. *Cleavage* basal, highly perfect. *Imperfect crystallizations:* structure columnar, particles delicate, straight, and parallel or divergent.

H.=2—2·5. G.=5·5—5·8; 5·564, Haidinger. *Lustre* metallic. *Streak* and *color* steel-gray. Opaque. Sectile.

Composition, according to H. Rose, (Pogg. viii, 101,)

Sulphur,	22·15	22·53
Antimony,	34·40	34·90
Lead,	40·75	38·71
Lead, with traces of iron and zinc,	——	0·74
Copper,	0·13	0·19
Iron,	2·30=99·73	2·65=99·72

Before the blowpipe, in an open tube, it affords dense white fumes of oxyd of antimony.

Obs. It occurs principally in Cornwall, associated with quartz and minute crystals of Bournonite; occasionally also in Siberia, and it is said in Hungary. Its perfect cleavage at right angles with the vertical axis, is sufficient to distinguish it from the species it resembles. It was first ranked as a species by Mohs, and named in honor of Prof. Jameson, of Edinburgh

FEATHER ORE. Lycites capillaris.

Plumose Antimonial Ore. Federerz.

In fine capillary crystallizations, resembling a cobweb. *Color* dark lead-gray.

Composition, according to Rose, (Pogg. xv, 471,) Sulphur 19·72, antimony 31·04, lead 46·87, iron 1·30, zinc 0·08=99·01.

Fuses instantly in the flame of a candle, evolving white fumes.

Obs. It occurs at Wolfsberg in the Eastern Hartz.

BOULANGERITE. Lycites Boulangeri.

Sulphuret of Antimony and Lead, *C. Boulanger*, Ann. des Mines, 2d ser. viii, 575. Plumbostib. Embrithite, *Br.* Schwefelantimonblei.

In plumose masses, exhibiting in the fracture a crystalline structure; generally massive.

H.=2·5. G.=5·97. *Lustre* metallic. *Color* bluish lead-gray.

Composition, according to Boulanger, (A. des Mines, viii, 575,) Bromeis, (Pogg. xlvi,) and Abendroth, (Pogg. xlvii, 495, 1839,)

	Molières.	Nertschinsk.	Ober-Lahr.
Lead,	53·9	56·288	55·60
Antimony,	25·5	25·037	25·40
Sulphur,	18·5	18·215	19·05
Iron,	1·2	——	——
Copper,	0·9=100, Boul.	——=99·54, Br.	——=100·05, Ab.

Fuses readily before the blowpipe, with exhalations of sulphurous acid and fumes of white oxyd of antimony. On charcoal, a yellow circle indicates the presence of lead. Easily attacked by nitric acid. Boiling strong muriatic acid decomposes it with the extrication of sulphuretted hydrogen.

Obs. Occurs quite abundantly at Molières, department of Gard, in France; also at Nasafjeld in Lapland, and at Nertschinsk and Ober-Lahr.

ARSENICAL ANTIMONY. Lycites alliaceus.

Arseniet of Antimony, *Thom.* Min. i, 84. Arsenikantimon.

In reniform masses and amorphous; structure fine granular.

H.=2–4. G.=6·13, Thomson; 6·2. *Lustre* metallic, occasionally splendent; sometimes dull. *Color* tin-white, or reddish-grey.

Composition of the Allemont ore, according to Rammelsberg, (Repert. Min. 1843, p. 13.) Antimony 62·15, and arsenic 37·85.

Before the blowpipe it emits fumes of arsenic and antimony, and fuses to a metallic globule, which takes fire and burns away, leaving oxyd of antimony on the charcoal.

Obs. It occurs sparingly at Allemont; also at Przibram in Bohemia, where it was observed by Zippe in metallic veins, associated with blende, antimony, spathic iron, &c.

KOBELLITE. Lycites bismutiferus.

Setterberg, K. V. Ac. H, 1839, p. [illegible].—Jahresb. xx, 205.

Resembles sulphuret of antimony, but with a brighter lustre; structure radiated.

G.=6·29—6·32. *Streak* black.

Composition, according to Setterberg,

Sulphuret of antimony 12·70, sulphuret of lead 46·36, sulphuret of bismuth 33·18, protosulphuret of iron 1·72, sulphuret of copper 1·08, gangue 1·45=9[illegible].

Fuses before the blowpipe, covering the coal with yellow, and a large part evaporates, leaving a white metallic globule. Dissolves in muriatic acid with the evolution of sulphuretted hydrogen.

Obs. Kobellite comes from the cobalt mine of Hvena in Sweden. It was discovered by Setterberg, and named in honor of Von Kobell.

GALENA. Plumbites cubicus.

Hexahedral Lead Glance, *M.* Sulphuret of Lead Blue Lead. Bleiglanz, Blau-Bleierz, *W.* Bleischweif. Plomb Sulfuré, *H.* Plumbum Galena, *Linn.*

Primary form, the cube. *Secondary forms*: figures from 1 to 23, Pl. I, and frequently several of them combined. *Cleavage* highly perfect and easily obtained, parallel to the faces of the cube. *Compound crystals*: fig. 129, Pl. II; the same kind of composition frequently repeated. *Imperfect crystallizations*: reticulated, tabular, and other imitative shapes; also massive, structure granular—coarse or fine, sometimes impalpable; occasionally fibrous. *Pseudomorphs*: imitative of pyromorphite, &c.

H.=2·5—2·75. G.=7·532—7·652. *Lustre* metallic. *Streak* and *color* pure lead-gray. Surface of crystals occasionally tarnished. *Fracture*, when obtainable, flat, subconchoidal, or even. Easily frangible.

Composition, when pure, Sulphur 13·45, lead 86·55. Prof. Beck found a specimen from Rossie to consist of Sulphur 13·26, lead 85·35, carbonate of lime and loss 1·39, (Min. N. Y., p. 49.) Before the blowpipe it decrepitates, unless heated with caution, when it fuses, gives off sulphur, and at last affords a globule of pure lead.

Galena often contains a small per centage of native silver, and is then called *Argentiferous Galena.* Mixtures with zinc blende and pyrites, its common associates, are frequent, and sometimes interfere with working the ore. Lerch found in two analyses of cubical crystals from Przibram, 2·18, and 3·59 per cent. of zinc; the specific gravity of the first was 7·324, and that of the second, 7·252, (Ann. de Ch. u. Ph. xlv, 325.) The *supersulphuretted Lead* from Dufton, analyzed by Johnston, afforded Sulphuret of lead 90·38, sulphur 8·71. As Rammelsberg remarks, it is probably nothing but common galena, with disseminated sulphur. Thomson found in another sulphuretted galena from Ireland, Sulphuret of lead 98·21, sulphur 1·79, (Min. 1, 552.)

Obs. Galena occurs in beds and veins, both in primary and secondary rocks. It is often associated with zinc blende, iron and copper pyrites, the carbonate and other lead ores, and occurs usually in a gangue of heavy spar, calc spar, or quartz.

At Freiberg in Saxony, it occupies veins in gneiss; at Clausthal and Neudorf in the Hartz, and at Przibram in Bohemia, it traverses similar veins in clay slate; at Sala in Sweden, it forms veins in primitive limestone; though the gray-wacke of Leadhills and the Killas of Cornwall, are disseminated veins of this ore; and in transition or mountain limestone, occur the rich repositories of Derbyshire, Cumberland, and the northern districts of England, as also those of Bleiberg, and the neighboring localities of Carinthia. In the English mines it is associated with calcareous spar, pearl spar, fluor spar, heavy spar, Witherite, calamine, and blende.

The most extensive deposits of this ore in the United States, and probably in the world, are met with in Missouri, Illinois, Iowa, and Wisconsin.

The lead region of Wisconsin, according to Mr. D. D. Owen, comprises 62 townships in Wisconsin, 8 in Iowa, and 10 in Illinois, being 87 miles from east to west, and 54 miles from north to south. The rock which affords the ore is the same fossiliferous limestone as in Missouri, the "cliff limestone" of Mr. Owen. It is associated with calc spar, calamine, and blende, the "dry bone" and "black jack" of the miners, and sometimes with carbonate of lead and ores of copper. The ore is inexhaustible, and throughout this region there is scarcely a square mile in which traces of lead may not be found. The principal diggings,

tions in the eyes of the miners, as stated by Mr. Owen, are the following: fragments of calc spar in the soil, [illegible] very abundant, which then indicate that the vein is wholly calcareous, or nearly so; red color of the soil on the surface, arising from the ferruginous clay in which the lead ore is often imbedded; fragments of lead ("gravel mineral") along with the crumbling magnesian limestone, and dendritic specks distributed over the rock; also a depression of the country, or elevation, in a straight line, or "sink holes," or a peculiarity of vegetation in a linear direction, indicates often the course of a vein. The diggings seldom exceed 25 or 30 feet in depth. From a single spot, not exceeding 50 yards square, 3,000,000 lbs. of ore have been raised; and at the new diggings on the west branch of the Peccatonica, not over 12 feet deep, two men can raise 2,000 lbs. per day; and in one of the townships, two men raised 16,000 lbs. in a day. 500 lbs. is the usual day's labor, from the mines of average productiveness. The furnaces in this lead region smelted out about 30,000,000 lbs. of lead in the year 1839. The metal in St. Louis brings about four cents per pound.

Galena also occurs at Cave-in-Rock in Illinois, associated with fluor spar. A vein at Rossie, in St. Lawrence Co. N. Y., traverses, nearly perpendicularly, the gneiss of the region, varying from one to three or four feet in width. Other deposits have been discovered in the same region, some apparently in the direction of the main vein, and others remote from it. It is associated with calcareous spar in fine crystallizations, and also iron and copper pyrites, and some blende and celestine. The ore of this region sometimes presents large and well-defined crystals. Near Wurtzboro', Sullivan Co., a large vein occurs in millstone grit; the ore is abundant, and mostly massive, either fine or coarsely granular. It is associated with blende, iron and copper pyrites. The Ancram lead mines, Columbia Co., have afforded considerable lead, but are no longer worked. In Maine, veins of considerable extent exist at Lubec, where the ore is associated with copper pyrites and blende; also less extensively at Blue Hill Bay, Bingham, and Parsonsfield; in New Hampshire at Eaton, with blende and copper pyrites, and also at Haverhill, Bath, and Tamworth. Southampton, Leverett, and Sterling, Mass., afford small quantities of Galena; also at Austin's mines in Wythe Co., Walton's gold mine in Louisa Co., and at other places in Virginia, it occurs in small quantities; at Brown's Creek, and at Haysboro', near Nashville, it occurs with blende and heavy spar. An argentiferous variety occurs sparingly at Monroe, Conn., which afforded Prof. Silliman, by cupellation, 3 per cent. of silver.

Galena is the great source of the lead of commerce. The *argentiferous* lead ore worked in England, for its silver, amounted in 1837 to about 40,000 tons, of which one half contained 8 to 8½ oz. of silver to the ton of lead, and the remaining 20,000 tons, only 4 to 5 oz. The separation, according to Patterson's new process, is effected by stirring the melted mass of lead as it cools, with an iron rod, to which the silver adheres in crystalline crusts. An ore containing only 3 oz. of silver to the ton of lead, may thus be profitably worked, and with little loss of lead.

COBALTIC LEAD ORE. PLUMBITES COBALTIFERUS.

Cobaltic Lead Glance, or Cobaltic Galena, *J.* Kobaltbleierz, *Haus.*

Occurs in minute moss-like groups of crystals, possessing cleavage; also massive.

Soft and sectile. Soils a little. G.=8·44. *Lustre* metallic and shining. *Color* lead-gray, inclining to blue. Opaque.

Composition, according to Du Menil, Lead 62·89, arsenic 22·47, sulphur 0·47, iron 2·11, cobalt 0·94, arsenical pyrites 1·44=90·32. Before the blowpipe it decrepitates; it colors glass of borax a smalt-blue.

OBS. It occurs in a vein of clay-slate and brown spar, traversing gray-wacke, in one of the Clausthal mines in the Hartz.

CLAUSTHALITE. PLUMBITES SELENIFERUS.

Seleniuret of Lead. Seleniet of Lead. Selenblei of the Germans. Plomb Séléniuré, Beud.

Occurs commonly in fine granular masses; in some specimens a foliated structure is apparent.

H.=2—2·5. G.=7·187. *Lustre* metallic. *Streak* dark-gray. *Color* lead-gray, somewhat bluish. Opaque. *Fracture* granular and shining. Rather sectile.

Composition, according to H. Rose (Pogg. Ann. ii, 415) and Stromeyer, (ibid. p. 403,)

Lead,	71·81	70·98
Selenium,	27·59	28·11
Cobalt,	——=99·40, R.	0·83=99·92, T.

Before the blowpipe, in addition to the usual phenomena arising from the presence of lead, it gives off the odor of horse-radish, and deposits on the charcoal a reddish-brown substance. Heated in a glass tube, closed at one end, the selenium almost immediately sublimes, forming a red ring within the tube, and on heating the tube to redness, the ore fuses, and the red ring partially disappears, and a white crystalline deposit remains.

Obs. Clausthalite much resembles a granular galena; but its color is somewhat peculiar in its slight tinge of blue. It occurs only massive in a vein of hematite, near Harzgerode in the Hartz.

Selenid of lead and cobalt (Selenkobaltblei) resembles the above, and may be a mechanical mixture. *Composition*, according to Rose, (Pogg. iii, 288,) Selenium 31·42, lead 63·92, cobalt 3·14, iron 0·45=98·93.

SELENID OF LEAD AND COPPER. PLUMBITES PALLIDUS.

Selenbleikupfer *of the Germans.*

Massive; texture fine-granular.

H.=2—2·5. G.=5·6. *Lustre* metallic. *Color* light lead-gray. *Fracture* conchoidal—uneven.

Composition, according to Rose, (Pogg. iii, 290,) Selenium 36·91, lead 48·31, copper 14·78.

Fuses readily before the blowpipe, with the reaction of lead and copper. Selenium not sublimed when heated in a glass tube.

Obs. Occurs at Tilkerode in the Hartz.

SELENID OF COPPER AND LEAD. PLUMBITES CUPRO-SELENICUS.

C. Kersten, Pogg. xlvi, 265, 1839. Selenkupferblei *of the Germans.*

Massive; texture more or less fine-granular. *Cleavage* distinct in two or more directions.

H.=2·5. G.=6·95—7·04, Kersten. *Lustre* metallic. *Streak* shining; *powder* grayish-black. *Color* dark lead-gray.

Composition, according to Kersten, (Pogg. xlvi, 265,) Lead 53·74, copper 8·02, selenium 30·00, quartz 4·50, peroxyd of iron 2·00, silver 0·05, sulphur *a trace*=98·31.

Heated in a glass tube, selenium is sublimed. Heated on a coal before the blowpipe, a brownish-red vapor is given off with the strong odor of selenium, leaving a shining slag of a grayish-black color. The slag, treated with borax in the reduction flame, takes after a while a beryl-green color, and finally affords a gray malleable globule, which in the oxydation flame covers the coal with oxyd of lead.

Obs.—This ore was met with at Tannenglasbach, near Hilberghausen, where it occurs with malachite, galena, copper pyrites, &c. It somewhat resembles a granular variety of galena.

A *third* selenid of lead and copper afforded Kersten Lead 63·82, selenium 29·35, copper 4·00, silver 0·07, quartz 2·06, sulphur and iron *a trace*=99·30. *Color* reddish lead-gray, approaching cochineal-red. *Streak* shining; *powder* grayish-black. H.=2·5—3. G.=7·4—7·45, Kersten. *Fracture* even or uneven. Another allied variety consists of lead 59·67, selenium 29·96, copper 7·86, with less than one per cent. of iron. These are probably mixtures of Clausthalite and the above species.

SELENID OF MERCURY AND LEAD. PLUMBITES FUSILIS.

Selenquecksilberblei *of the Germans.*

Primary form, a cube. *Cleavage* cubic. In foliated grains or masses.

H.=7·3. *Color* lead-gray to bluish and iron-black.

Composition, according to Rose,

Selenium,	24·97	27·98
Lead,	55·84	27·33
Mercury,	16·94=97·75	44·69=100

Odor of selenium before the blowpipe. Yields mercury with soda.
OBS. Occurs at Tilkerode.

TELLURID OF LEAD. PLUMBITES ALBUS.

Tellurblei.

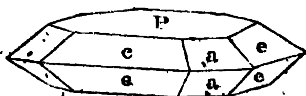
Primary form, supposed to be tesseral—massive, with cleavage in three directions at right angles with one another.

H.=3, G.=8·159. *Lustre* metallic. *Color* tin-white, resembling that of native antimony. Sectile.

Composition, according to G. Rose, (Pogg. xviii, 68,) Tellurium 38·37, lead 60·35, and silver 1·28. Volatilized in the reducing flame of the blowpipe, excepting a minute bead of silver. Colors the flame blue.
OBS. It occurs at Savodinsky in the Altai mountains.

FOLIATED TELLURIUM. PLUMBITES FOLIACEUS.

Pyramidal Tellurium Glance, *M.* Bitellurct of Lead, *Thom.* Black Tellurium, *P.* Tellurium Glance. Nagyager-erz, *W.* Blättertellur, *Haus.* and *L.* Blättererz. Tellure Natif Aurifère et Plombifère, Tellure Natif Auro-Plombifère, *H.*



Primary form, a right square prism. *Secondary form:* P : e=110°, e : e=140°, P : a=118° 35′, a : a=122° 50′. *Cleavage* perfect, parallel with P. Occurs also granularly massive; particles of various sizes, sometimes slightly elongated, but generally foliated.

H.=1—1·5. G.=7·085. *Lustre* metallic. *Streak* and *color* blackish lead-gray. Opaque. Sectile. Flexible in thin laminæ.

Composition, according to Klaproth, (Beit. iii, 32) and Brandes, (Schweigger's J. xxxv, 409,)

Tellurium,	32·2	31·96
Lead,	54·0	55·49
Gold,	9·0	8·44
Silver,	0·5	trace
Copper,	1·3	1·14
Sulphur,	3·0=100, K.	3·07=100·10, B.

Before the blowpipe, on charcoal, it fuses readily to a malleable metallic button, tinging the flame at the same time blue, and covering the charcoal with white fumes. With borax it affords a bead of gold, with a little silver. It dissolves partially in nitric acid, and entirely in nitro-muriatic.

OBS. It occurs at Nagyag and Offenbanya in Transylvania, in foliated masses and crystalline plates, accompanying, at the former place, silicate of manganese, blende, and gold; and at the latter, associated with antimony ores.

Berthier has analyzed another ore very similar to the above in physical characters, consisting of Tellurium 13·0, sulphur 11·7, lead 63·1, gold 6·7, antimony 4·5, copper 1·0.

MOLYBDENITE. ELASMITES HEXAGONUS.

Rhombohedral Molybdena-Glance, *M.* Sulphuret of Molybdena, *P.* Bisulphide of Molybdenum, *Thom.* Molybdänglanz, *L.* Wasserblei, *W.* Molybdene Sulfuré, *H.*

Primary form, a hexagonal prism. *Secondary form:* flat hexagonal prisms with replaced terminal edges. *Cleavage* basal, eminent. Occurs commonly in foliated masses.

H.=1—1·5. G.=1·569, Karsten; 4·7385, Brisson. *Lustre* metallic. *Streak* similar to color, slightly inclined to green. *Color* pure lead-gray. Opaque. *Fracture* not observable. Thin laminæ highly flexible, but not elastic. Sectile, and almost malleable.

Composition, according to Bucholz, (Gehlen's Journ. iv, 60,) Molybdenum 60, and sulphur 40=100. Does not fuse before the blowpipe, but sulphureous fumes are emitted, which are deposited on the charcoal. Dissolves in nitric acid, excepting a gray residue. Deflagrates with nitre.

OBS. Molybdenite generally occurs imbedded in, or disseminated through, granite, gneiss, zircon-syenite, and other primitive rocks. At Numedahl in Sweden, and Arendal in Norway, and Greenland, it has been observed in hexagonal prisms. The secondary form is exceedingly rare. Altenberg in Saxony, and Schlaggenwald and Zinnwald in Bohemia, are among its foreign localities. At Caldbeck Fell in Cumberland, it is associated with tungstate of lime and apatite; it also occurs at several of the Cornish mines.

At Haddam, Conn., and the adjoining towns on the Connecticut river, it occurs in gneiss in crystals and large plates; at Saybrook it is associated with stilbite. At Westmoreland, Vt., there is a large vein of molybdenite, where it occurs in granular masses of considerable size, and is associated with crystals of white apatite. Other localities are at Shutesbury, Mass., east of Locke's pond; at Brimfield, along with iolite; in New Hampshire, at Westmoreland, four miles south of the north village meeting-house, in a vein in mica-slate, where it is abundant, and fine specimens may be obtained; at Landaff in regular tabular crystals; at Franconia; in Maine, at Blue Hill Bay and Camdage farm in large crystallizations; also at Brunswick and Bowdoinham, but less interesting; in New York, two miles southeast of Warwick, in irregular plates associated with rutile, zircon, and pyrites.

This mineral is readily distinguished from plumbago by its lustre and streak, and also by its behavior before the blowpipe and with acids.

SULPHURET OF BISMUTH. BISMITES RECTANGULUS.

Prismatic Bismuth Glance, *M.* and *J.* Bismuthine. Wismuthglanz *of the Germans.* Bismuth Sulfuré, *H.*

Primary form, a right rectangular prism. Lateral planes *e*, longitudinally striated; $\breve{M}$: *e*=about 135° 30′, *e* : *e*=91° 30′. *Cleavage:* $\breve{M}$ perfect; $\bar{M}$ less so; P imperfect. The above angle, 91½°, was obtained by Brooke, by a measurement of artificial crystals of sulphuret of bismuth. It occurs generally either in acicular crystals, or massive, with a foliated or fibrous structure.

H.=2—2·5. G.=6·549. *Lustre* metallic. *Streak*, and *color* lead-gray. Opaque. Sectile.

Composition, according to Rose (Gilbert's Annalen, lxxii, 192) and Wehrle, (Jahresbericht, 1833, p. 177,)

Sulphur,	18·72	18·28
Bismuth,	80·98=99·70, R.	80·96=99·24, W.

It fuses in the flame of a candle; before the blowpipe it is volatilized, and covers the charcoal with a yellow areola, during which it continually throws out small drops in a state of incandescence. Dissolves readily in hot nitric acid, from which a white precipitate falls, on diluting it with water.

Foliated masses of sulphuret of bismuth accompany molybdenite and apatite in quartz, at Caldbeckfell in Cumberland. In Cornwall it occurs in acicular prisms with pyrites. At Johanngeorgenstadt, both massive and acicular crystallizations are met with in limestone. It is associated with cerium ore at Bastnaes in Sweden.

It is said to have been observed at Haddam, Conn., associated with chrysoberyl, beryl, automolite, garnet, and Columbite.

Unlike native bismuth, this ore does not effervesce in cold nitric acid. By this test, these two species may be distinguished, when other characters fail. It is more fusible than galena, and less volatile than gray antimony.

ACICULAR BISMUTH. Bismites acicularis.

Prismatoidal Bismuth-Glance, *M.* Needle Ore, *J.* Plumbo-Cupriferous Sulphuret of Bismuth. Nadelerz *of the Germans.* Bismuth Sulfuré, Plumbo-Cuprifère, *Levy.*

Occurs in imbedded acicular crystals; also massive.

H.=2—2·5. G.=6·125, John. *Lustre* metallic. *Color* blackish lead-gray, with a pale copper-red tarnish. Opaque. *Fracture* uneven.

Composition, according to John, (Gehlen's Jour. 2d ser, v, 227,)

Bismuth,	43·20
Lead,	24·32
Copper,	12·10
Nickel?	1·58
Tellurium?	1·32
Sulphur,	11·58
Gold,	0·79=94·89

Before the blowpipe it gives off fumes of sulphur, fuses, and emits numerous burning globules, and yields a bead of lead containing copper, which colors glass of borax greenish-blue.

Obs. Acicular bismuth occurs imbedded in white quartz, and accompanies gold, malachite, and galena, at Beresof, near Ekatherinenberg in Siberia. It was first described and analyzed by John and Karsten.

Another variety of cupreous bismuth has been observed in certain mines near Wittichen, in Furstenberg. Its color is pale lead-gray, passing into tin-white—subject to tarnish; streak black; composition, according to Klaproth, Bismuth 47·24, copper 34·66, sulphur 12·58=94·48. It is associated with native bismuth and copper pyrites, which constitute veins traversing granite.

An ore of bismuth, according to Jackson, occurs at the Lubec lead mines, in Maine.

TETRADYMITE. Bismites rhombohedrus.

Telluric Bismuth. Telluret of Bismuth. Bornite. Tellurwismuth.

Primary form, a rhombohedron, R : R=66° 40′. *Cleavage* perfect parallel with a.

G.=7·514, Baumgärtner; 7·5, Werhle. *Lustre* metallic. *Color* pale steel-gray. Not very sectile. *Laminæ* elastic. *Soils* paper like molybdenite.

Composition, according to Werhle, (Schweig. J. lix, 482,) and Berzelius, (K. V. Ac. H. 1823, p. 183.)

Bismuth,	59·84	58·30
Tellurium,	35·24	36·05
Sulphur,	4·92	4·32
Matrix,	——=100, W.	0·75=99·42, B.

It fuses instantly in the blowpipe flame, and soon volatilizes, covering the charcoal with a yellow coating. It dissolves, when pulverized, in nitric acid, excepting the sulphur, which is precipitated.

Obs. It occurs at Schemnitz, Retzbanya, and at San José in Brazil, and was first noticed by Baron Von Born.

The *Molybdicsilver*, (molybdän silber,) from Deutsch-Pilsen, has nearly the same physical characters. G. 8—8·4. *Composition*, according to Werhle, Tellurium 29·74, sulphur 2·33, bismuth 61·15, silver 2·07 = 95·29.

RIONITE. Zincites flammans.

Selenuet of Zinc. Selenid of Zinc. Selenquecksilberzink. Eulebrite, *Brooke*.

Massive.

G. =5·56. *Lustre* metallic or earthy. *Streak* blackish, when the color is lead-gray. *Color* lead-gray—cochineal-red.

Composition of the gray variety, according to Del Rio, Selenium 49, zinc 24, mercury 19, and sulphur 1·5, with 6 per cent of lime from the gangue.

Before the blowpipe it burns with a fine violet-colored flame, and exhales selenium with the strong odor of horse-radish. When heated in a retort, selenium, mercury, and a little sulphur, sublime.

Obs. This species was discovered by Del Rio, in 1817, at Calebras, in the mining district of El Doctor, in Mexico, where it occurs in limestone which is imbedded in red sandstone.

SELENID OF MERCURY. Hydrargyrites alliaceus.

Merkurglanz, *Br.* Selenschwefelquecksilber.

Massive; texture compactly granular: no cleavage.

H.=2·5. *Lustre* metallic. *Streak* shining. *Color* steel to blackish lead-gray.

Composition, according to H. Rose, (Pogg. xlvi, 315,)

Selenium 6·49, sulphur 10·30, mercury 81·33=98·12.

Or.

Selenid of mercury 23·10, and sulphuret of mercury 75·11=98·21:

On charcoal before the blowpipe it gives off the odor of selenium, and a white incrustation covers the coal.

Obs. Occurs with other ores of mercury in Mexico, near San Onofre. It has nearly the color and lustre of Fahlerz.

ORDER XI.—ADELINEA.

MANGANBLENDE. Acarpia cubica.

Hexahedral Glance-blende, *M.* Sulphuret of Manganese, *P.* Manganblende, *Breit.* Schwarzerz, *Haus.* Manganglanz, *L.* Manganèse Sulfuré, *H.*

Primary form, the cube. *Secondary form:* the regular octahedron. *Cleavage* perfect parallel with the primary faces. Occurs also granularly massive.

H.=3·5—4. G.=3·95—4·014. *Lustre* submetallic. *Streak* green. *Color* iron-black, tarnished brown on exposure. *Fracture* uneven.

Composition, according to Klaproth, (Beit. iii, 35,) Vauquelin, and Arfvedson, (K. V. Ac. H. 1822,)

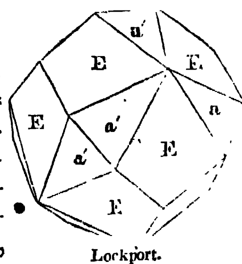
Protoxyd of manganese,	82	85	Manganese, 62·10
Sulphur,	11	15	37·90
Carbonic acid,	5=98, K.	——=100, V.	——=100, A.

Fuses on the thinnest edges before the blowpipe. When pulverized and thrown into muriatic acid, or dilute sulphuric acid, sulphuretted hydrogen is evolved.

Obs. Manganblende occurs in veins, in the gold mines of Nagyag in Transylvania, associated with tellurium, carbonate of manganese, and quartz.

BLENDE. Acarpia dodecahedra.

Dodecahedral Garnet-Blende, *M.* Sulphuret of Zinc. Black Jack. Blende *of the Germans.* Zinc Sulfuré, *H.* Pseudo-galena. Zincum sterile, *Linn.*



Lockport.

Primary form, the rhombic dodecahedron. *Secondary forms:* figs. 1, 6, 8, 9, 30, 32, Pl. I; also the annexed figure, in which the acute solid angles are replaced by two instead of four secondary planes. Sometimes this modification is accompanied by a truncation of the alternate obtuse solid angles of the dodecahedrons. *Cleavage* dodecahedral, highly perfect. *Compound crystals:* similar to fig. 129, Pl. II; occurs parallel to the same faces (A, fig. 4, or a, fig. 8) in several of the secondary forms. This composition is often repeated. *Imperfect crystallizations:* botryoidal, and

other imitative shapes—structure columnar—impalpable; also amorphous, with a similar structure.

H.=3·5—4. G.=4·027—4·078. *Lustre* adamantine—resinous. *Streak* white—reddish-brown. *Color* brown, black, yellow, red, green, none bright; yellow, when pure. Transparent—translucent. *Fracture* conchoidal. Brittle.

Composition, according to Arfvedson, (K. V. Ac. H., 1822, p. 438,) Berthier, (Ann. des Mines, ix, 420,) and Thomson, (Min. i, 540,)

		Brown.	
Zinc,	66·34	63·0	66·000
Sulphur,	33·66	33·6	32·628
Iron,	——=100, A.	3·4=100, B.	1·372=100, T.

It often, however, contains a large portion of iron; in one specimen Thomson detected 20·74 per cent. The *Marmatite* (from Marmato in the province of Popayan) is a black blende, consisting of sulphuret of zinc 77·1 and sulphuret of iron 22·9. The fibrous blende of Przibram afforded Löwe 1·5 to 1·8 per cent. of cadmium; and a red blende from Beaujeu, examined by Damour, (J. fur prak. Chem. xiii, p. 351,) was found to contain 1·136 of cadmium.

Blende is infusible both alone and with borax. By a strong heat in the oxydating flame of the blowpipe, vapors of zinc are evolved, which coat the charcoal. Dissolves in nitric acid, during which sulphuretted hydrogen is disengaged. Some specimens phosphoresce when struck with a steel or by friction.

OBS. Blende occurs in both primary and secondary rocks, and is usually associated with galena; also with heavy spar, copper pyrites, fluor, spathic iron, and frequently it occurs in silver mines.

Derbyshire, Cumberland, and Cornwall, afford the black varieties; also Transylvania, Hungary, and the Hartz. Sahla in Sweden, Ratieborzitz in Bohemia, and many Saxon localities, afford splendid black and brown crystals. A variety having a diverging fibrous structure, and presenting botryoidal forms, is met with at Fowey.

Blende abounds with the lead ore of Missouri, Wisconsin, Iowa, and Illinois. In Sullivan Co., N. Y., near Wurtzboro, it constitutes a large part of an extensive lead vein in millstone grit, and is occasionally crystallized in octahedrons. In St. Lawrence Co., N. Y., brown blende occurs at Cooper's falls in a vein of carbonate of lime, at Mineral Point with galena, and in Fowler, on the farm of Mr. Belmont, in a vein with iron and copper pyrites traversing serpentine; at the Ancram lead mine, in Columbia Co., of yellow and brown colors; in limestone at Lockport, in honey and wax-yellow crystals that are often transparent; in minute crystals with galena on Flat creek, two miles southeast of Spraker's basin, in the town of Root, N. Y. In Massachusetts it occurs at Sterling of a cherry-red color, with galena; also a yellowish-brown variety at the Southampton lead mines; also at Hatfield with galena: in New Hampshire at the Eaton lead mine it is abundant; at Warren there is a large vein of black blende: in Maine it occurs at the Lubec lead mines; also at Bingham, Dexter, and Parsonsfield: in Connecticut, a yellowish-green variety is met with at Brookfield; at Berlin of a yellow color; brownish-black at Roxbury, and yellowish-brown at Lane's mine, Monroe: in Pennsylvania at the Perkiomen lead mine: in Virginia at Walton's gold mine, Luzerne Co., and more abundantly at Austin's lead mines, Wythe Co., where it occurs crystallized, or in radiated crystallizations: also at Haysboro, near Nashville, Tenn.

The *Leber-blende* (hepatic-blende) of Breithaupt, (J. fur pr. Ch. xv, 321,) contains carbon, and is considered by Berzelius common zinc-blende, impure with a mineral resin, or some other mineral with carbon in its composition.

VOLTZITE. ACARPIA ROSEA.

In implanted spherical globules.

H.=4·5. G.=3·66. *Lustre* vitreous to greasy; or pearly on a cleavage surface. *Color* dirty rose-red, yellowish. Opaque or subtranslucent.

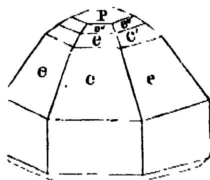
Composition, according to Fournet, Sulphuret of zinc 82·92, oxyd of zinc 15·34, peroxyd of iron 1·84=100·10.

In muriatic acid, evolves fumes of sulphuretted hydrogen.

Obs. Occurs at Rosiers in the department of Puy de Dome. The same compound has been observed by Kersten in the slags of the iron works of Freiberg.

GREENOCKITE. Acarpia hexagona.

Brooke and *Connel*, Jameson's Jour. xxviii, 390; *Breithaupt*, Pogg. li, 274.



Primary form, a hexagonal prism. *Secondary*, the prism, with the terminal edges replaced by one or more planes; P : e′=136° 24′, P : e=117° 42′, P : e″=154° 32′, M : e′=133° 36′, M : e=152° 18′, M : e″=115° 28′. e″ : e″ (adjoining)=155° 29′, e′ : e′ (adjoining)=139° 39′, e′ : e′ (over M)=87° 13′, e : e (adjoining)=127° 26′. *Cleavage* lateral, distinct; basal imperfect.

H.=3—3·5. G.=4·8, Brooke; 4·9—4·909, Breithaupt. *Lustre* adamantine. *Color* honey-yellow—orange-yellow—veined parallel with the axis. *Streak powder* between orange-yellow and brick-red. Nearly transparent—strong double refraction. Not thermo-electric, (Breithaupt.)

According to Connel, Greenockite is a simple sulphuret of cadmium, and consists of Sulphur 22·4, and cadmium 77·6.

Before the blowpipe on charcoal it is decomposed, and a yellowish-red ring of oxyd of cadmium is deposited.

Obs. Greenockite occurs in short hexagonal crystals at Bishopton in Renfrewshire, Scotland, in a porphyritic trap and amygdaloid, associated with prehnite. It is named in honor of Lord Greenock, its discoverer.

RED ANTIMONY. Cerasia rhomboidea.

Prismatic Purple Blende, *M.* Prismatic Antimony Blende, *J.* Rothspiesglaserz, *W.* Rothspeissglanzerz, *Hau.* Antimonblende, *L.* Antimoine Hydro-Sulfuré, Antimoine Oxydé Sulfuré, *H.*, Pyrantimonite, *Br.*

Primary form, a right rhomboidal prism; M : T=101° 19′. *Secondary form:* primary with the lateral edges (*e*) deeply replaced. *Cleavage* lateral, highly perfect. Usually in tufts of capillary crystals, consisting of elongated, slender, six-sided prisms. Also in flakes resembling tinder, resulting from an interlacing of minute individuals.

H.=1—1·5. G.=4·45—4·6. *Lustre* adamantine. *Streak* brownish-red. *Color* cherry-red. Feebly translucent. Sectile.

Composition, according to H. Rose, Antimony 74·45, oxygen 4·78, sulphur 20·49=99·72. Fuses readily on charcoal, and at last is entirely volatilized. In nitric acid it becomes covered with a white coating.

Obs. This rare mineral occurs in veins in quartz, accompanying gray and white antimony, at Malazka, near Posing in Hungary, at Braunsdorf, near Freiberg in Saxony, and at Allemont in Dauphiny. The tinder ore variety is found principally at Clausthal and Andreasberg in the Hartz.

MIARGYRITE. Rubella obliqua.

Hemi-prismatic Ruby-Blende, *M.* Bisulpho-antimoniate of Silver, *Thom.*

Primary form, an oblique rhombic prism; M : M=86° 4′, P : M =101° 6′. *Secondary forms:* similar to fig. 97, Pl. II; lateral planes deeply striated. *Cleavage* lateral, imperfect.

H.=2—2·5. G.=5·234. *Lustre* submetallic-adamantine. *Streak* dark cherry-red. *Color* iron-black. Opaque, except in thin splinters, which, by transmitted light, present a deep blood-red color. *Fracture* subconchoidal. Very sectile.

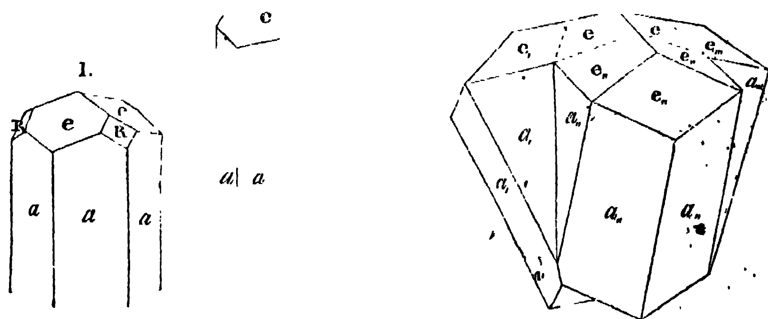
Composition, according to H. Rose, (Pogg. xv, 469,) Sulphur 21·95, antimony 39·14, silver 36·40, copper 1·06, iron 0·62=99·17. Before the blowpipe its action resembles that of the following species.

Obs. This rare species has been observed only in a mine at Braunsdorf, near Freiberg in Saxony, associated with argentiferous arsenical pyrites. It was first distinguished from red silver ore by Mohs. Its name is derived from μειων, *less*, and ἀργυρος, *silver*, and was given it because it contained less silver than some kindred ores.

DARK RED SILVER ORE. Rubella rhombohedra.

Rhombohedral Ruby-Blende, *M.* Ruby Silver, *P.* Black Silver. Subsesquisulpho-Antimoniate of Silver, *Thom.* Ærosite, Rothgültigerz, *W.* Dunkles Rothgultigerz, *G.* Argent Antimonié Sulfuré, *H.* Pyrargyrit, *Br.* Argentum Rubrum, *Linn.*

Primary form, an obtuse rhombohedron; R : R=108° 18′. *Secondary forms:*



R : e=144° 9′, e : e=137° 39′. The crystals are often differently modified at their two extremities. *Cleavage* rhombohedral, sometimes pretty distinct. *Compound crystals:* composition of the *second kind*; 1. parallel to e, or a plane truncating the terminal edge; this composition taking place parallel with each plane e at one extremity of the crystal, gives rise to the form represented in fig. 3, which is composed of four individuals; 2. parallel with *e* or a plane truncating a lateral edge; composition of the *third kind*, parallel to the

face *a*, (fig. 121, Pl. II,) which truncates the lateral angle. *Imperfect crystallizations:* structure granular, sometimes impalpable.
H.=2·5. G.=5·7—5·9, Breithaupt. *Lustre* metallic-adamantine. *Streak* cochineal-red. *Color* black, sometimes approaching cochineal-red. Translucent—opaque. *Fracture* conchoidal. Sectile, yielding readily to the knife.

Composition, according to Bonsdorf, (K. V. Ac. H., 1821, 338,) Silver 58·949, antimony 22·846, sulphur 16·609, earthy matter 0·299=98·703. Before the blowpipe it fuses and gives out fumes of antimony; ultimately a globule of silver is obtained. Partially dissolves in heated nitric acid.

OBS. The *dark red silver ore* occurs principally with calcareous spar, native arsenic, and galena at Andreasberg in the Hartz. In Saxony, Hungary, Norway, and at Gaudalcanal in Spain, are other localities. In Mexico it is worked extensively as an ore of silver.

It is highly valuable as an ore of silver. Cinnabar may be distinguished from this species, by its complete volatility before the blowpipe.

LIGHT RED SILVER ORE. RUBELLA FLORIDA.

Rhombohedral Ruby-Blende, *M.* Lichter Rothgültigerz. Proustite.

Primary form, an obtuse rhombohedron; R : R=107° 36′. *Secondary form:* similar to figs. 116 and 119, Pl. II. *Compound crystals:* similar to the preceding species. Occurs also granular.
H.=2—2·5. G.=5·422—5·56. *Lustre* adamantine. *Streak* cochineal-red, sometimes inclining to aurora-red. *Color* cochineal-red. Subtransparent—subtranslucent. *Fracture* conchoidal—uneven.

Composition, according to H. Rose, (Pogg. xv, 473,) Silver 64·67, arsenic 15·09, sulphur 19·51, antimony 0·69=99·96. Before the blowpipe its behavior is like the preceding species, except that fumes of arsenic are emitted.

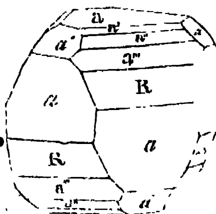
OBS. It occurs with other ores of silver, galena, blende, pyrites, and arsenic, at Marienberg, Annaberg, and Johanngeorgenstadt in Saxony, and at Joachimstahl in Bohemia. A group of crystals from the last locality, several inches long, and weighing upwards of six pounds, is now in the National Museum at Prague.

It is an important ore of silver. Red orpiment, which it sometimes resembles, differs from it in having a yellow streak.

The *Hypargyrite* of Breithaupt, from Clausthal, contains, according to Plattner, 35 per cent. of silver, with arsenic and sulphur, some iron, and a little antimony. G.=4·7—4·9.

CINNABAR. RUBELLA PERITOMA.

Peritomous Ruby-Blende, *M.* Sulphuret of Mercury. Zinnober *of the Germans.* Quecksilber-Lebererz, *W.* Stinkzinnober Lebererz, *Haus.* Corallinerz. Mercure Sulfuré, *H.* Κιννάβαρις, *Theoph.* c. 103. Ἄμμιον, *Dioscor.* V. c. 109, 110. Minium. *Vitruv. Plin.*



Primary form: an acute rhombohedron; R : R=71° 47′. *Secondary form:* R : a‴=157° 20′. R horizontally striated. *Cleavage* highly perfect parallel with *a*. *Compound crystals:* composition of the third kind—parallel with a, a plane truncating the terminal angle. *Imperfect crystallizations:* granular, usually fine, and often impalpable; sometimes forming superficial coatings.
H.=2—2·5. G.=8·098, a cleavable variety from Neumarktel

Lustre adamantine, inclining to metallic in dark colored varieties, and to dull in friable varieties. *Streak* scarlet-red. *Color* cochineal-red, the darker varieties inclining to brownish-red, and lead-gray. Subtransparent—subtranslucent. *Fracture* subconchoidal, uneven. Sectile.

Composition, according to Klaproth, (Gehlen's Journal, v. 436, 440,)

	Neumarktel.	*Liver Ore* from Idria.
Mercury,	85·00	81·80
Sulphur,	14·25=99·25	13·75=95·55

When pure it consists of Mercury 86·29, and sulphur 13·71.

In the liver ore, which is a compact variety of a brown color, in addition to the above, Klaproth found Carbon 2·30, silica 0·65, alumina 0·55, iron 0·20, copper 0·02, water 0·73.

Before the blowpipe it volatilizes readily, when pure. Dissolves in nitric acid.

Obs. The *hepatic cinnabar* or *liver ore*, is an impure variety of this species; it sometimes affords a brownish streak in consequence of its impurities, and is occasionally slaty, though commonly granular or impalpable in its structure.

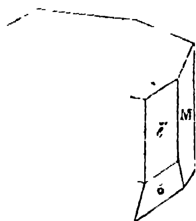
Cinnabar is usually associated in beds with native mercury, native amalgam, and occasionally only with calcareous spar and quartz. It has been observed in veins, with ores of iron.

The finest crystals of this species occur in the coal formations of Moschellandsberg and Wolfstein in the Palatinate; also in Japan, Mexico, and Brazil. The most important beds of this ore are at Almaden in Spain, and at Idria in Carniola, where it is usually massive. It occurs at Richenau in Upper Carinthia, in beds traversing gneiss at Dunbrawa in Transylvania, in gray-wacke, at Windisch Kappel in Carinthia, and at Neumarktel in Carniola. The variety *corallinerz*, from Idria, has a curved lamellar structure.

This ore is the great source of the mercury of commerce, from which it is obtained by sublimation. When pure, it is identical with the manufactured vermillion of commerce, which is a valuable pigment, and besides various other uses, is employed in coloring sealing wax. It was highly esteemed for its brilliancy of color by the ancients, and was employed as a paint for various sacred purposes.

REALGAR. Euchroa rubella.

Hemi-prismatic Sulphur, *M.* Red Orpiment or Ruby Sulphur, *J.* Red Sulphuret of Arsenic. Sulphide of Arsenic, *Thom.* Rothes Rauschgelb, *W.* Realgar, *Haus.* and *L.* Arsenic Sulfuré Rouge, *H.* Arsenicum Sandaraca, *Linn.* Σανδαρακη, *Theoph. Dioscor.* Sandaraca, *Plin. Vitr.*



Primary form, an acute oblique rhombic prism, M : M=74° 30′. *Secondary form*: ĕ′ : ĕ′=113° 20′, P : ĕ (plane truncating the edge between ĕ′ and ĕ′) =113° 16′. *Cleavage* parallel to P and the longer diagonal rather perfect; parallel to M and the shorter diagonal, in traces. Also granular, coarse or fine; compact.

H.=1·5—2. G.=3·642, Breithaupt; 3·384, Brisson. *Lustre* resinous. *Streak* varying from orange-yellow to aurora-red. *Color* aurora-red or orange-yellow. Transparent—translucent. *Fracture* conchoidal, uneven. Sectile; yields to the nail.

Composition, when pure, Sulphur 29·97, and arsenic 70·03=100. Fuses readily before the blowpipe and burns with a blue flame, and is dissipated in fumes of an alliaceous odor, with some sulphurous acid. By friction, it acquires negative electricity.

Obs. Fine crystallizations of this species have been observed with ores of silver and lead, at Felsobanya in Upper Hungary, at Kapnik and Nagyag in Transylvania, at Joachimstahl in Bohemia, at Schneeberg in Saxony, and at Andreasberg in the Hartz. At

Tajowa in Hungary, it occurs in beds of clay, and at St. Gothard in Switzerland, imbedded in dolomite. It has also been observed in the Vesuvian lavas, in minute crystals. Strabo speaks of a mine of *sandaraca* (the ancient name of this species) at Pompeiopolis in Paphlagonia.

Realgar has long been used as a pigment.

ORPIMENT. EUCHROA AUREA.

Prismatoidal Sulphur, *M.* Yellow Sulphuret of Arsenic. Sesquisulphide of Arsenic, *Thom.* Gelbes Rauschgelb, *W.* Rauschgelb, *Haus.* Operment. Auripigment, *L.* Arsenic Sulfuré Jaune, *H.* Resigallum. Auripigmentum, *Vitr.* 'Αρσενικόν, *Dioscor.* Αρρενῖκον, *Theoph.* Arsenicum, *Plin.*



Primary form, a right rhombic prism; M : M=100° 40′. *Secondary form*: M : e=140° 20′, M : ĕ =129° 40′, a : a=83° 37′, ĕ : a=138° 12′. *Cleavage* parallel with ĕ highly perfect; parallel with ē in traces; ĕ longitudinally striated.

H.=1·5—2. G.=3·48, Haidinger; 3·4, Breithaupt. *Lustre* metallic-pearly upon the faces of perfect cleavage; elsewhere resinous. *Streak* yellow, commonly a little paler than the color. *Color* several shades of lemon-yellow. Subtransparent—subtranslucent. Sectile. Thin laminæ obtained by cleavage, flexible, but not elastic.

Composition, Sulphur 39·10, and arsenic 60·90. It burns with a blue flame on charcoal before the blowpipe, and emits fumes of sulphur and arsenic. Dissolves in nitric, muriatic, and sulphuric acids.

OBS. Orpiment occurs in small crystals imbedded in clay, near Neusohl in Lower Hungary. It usually occurs in foliated and fibrous masses, and in this form is found at Kapnik in Transylvania, at Moldawa in the Bannat, and at Felsobanya in Upper Hungary, where it exists in metalliferous veins, associated with realgar and native arsenic.

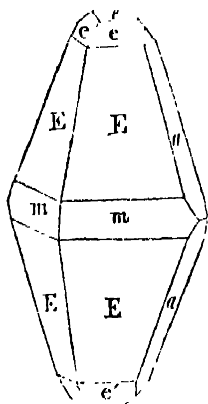
The name orpiment is a corruption of its Latin name auripigmentum, "*paint of gold*," which was so called in allusion to its color, and also because it was supposed to contain gold.

It is used as a pigment.

ORDER XII.—THEIINEA.

NATIVE SULPHUR. SULPHUR PYRAMIDALIS.

Prismatic Sulphur, *M.* and *J.* Native Sulphur. Naturlicher Schwefel. Soufre, *H.* Θεῖον.



Primary form, a rhombic octahedron; E : E (adjacent in the same pyramid) =106° 38′, and 84° 58′, E : E (adjacent but in different pyramids) =143° 17′. *Secondary form:* m : m=101° 59′, m : E=161° 39′, E : *a*=132° 29′, e′: e′ (adjacent) =127° 1′, p : e′=134° 53′, p : *a*=117° 48′. *Cleavage* parallel with E and m imperfect. *Compound crystals:* composition parallel with *p*. *Imperfect crystallizations:* imitative shapes and amorphous; composed of concentric coats; also fine granular, or impalpable.

H.=1·5—2·5. G.=2·072, crystals from Spain. *Lustre* resinous. *Streak* sulphur-yellow—yellowish-white. *Color* sulphur-yellow, sometimes reddish or greenish. Transparent—subtranslucent. *Fracture* conchoidal, more or less perfect. Sectile.

It is pure sulphur, but is often contaminated with clay or bitumen. It burns with a bluish flame at a low temperature, with the strong odor of sulphurous acid. It becomes resinously electrified by friction. It is insoluble in water, and is not acted upon by the acids.

Obs. Sulphur is one of the dimorphous substances, since its crystalline form varies fundamentally with the temperature at which crystallization takes place. Crystallized from fusion, it presents obtuse oblique rhombic prisms, in which M : M=90° 32′, and P : ė (plane truncating the obtuse or front lateral edge) =95° 46′.

The great repositories of sulphur are either beds of gypsum and the associate rocks, or the regions of active and extinct volcanoes. In the valley of Noto and Mazzaro in Sicily, at Conil near Cadiz in Spain, and Cracow in Poland, it occurs in the former situation. Sicily, and the neighboring volcanic isles, the Solfatara near Naples, the volcanoes of the Pacific ocean, &c., are localities of the latter kind. The crystals from Sicily are sometimes two or three inches in diameter. It is also deposited from hot springs in Iceland; and in Savoy, Switzerland, Hanover, and other countries, is met with in certain metallic veins. At Radoboy, near Crapina in Croatia, it occurs in imbedded spheroidal masses,

which have a brownish tinge, owing to the presence of bitumen. Stromeyer detected selenium in a dark reddish colored sulphur of the Lipari islands.

Sulphur is found as a deposit about the sulphur springs of New York, Virginia, &c., and occurs also in coal deposits and elsewhere where sulphuret of iron is undergoing decomposition; also in microscopic crystals at some of the gold mines of Virginia.

The sulphur mines of Sicily, the crater of Volcano, and the Solfatara near Naples, afford immense quantities of sulphur for commerce. Previous to becoming an article of commerce, it is purified by fusion or sublimation. The manufacture of gunpowder, of sulphuric acid, casts, cements, and various pharmaceutical preparations, are among the important processes in which sulphur is required.

CLASS III. HYPOGÆA.

ORDER I.—PITTINEA.

AMBER. Succinum Electrum.

Yellow Mineral Resin, M. Bernstein *of the Germans*. Succin, *H.* Succinum. Ηλεκτρον. Λυγκουριον. Lyncurion, *Demostr.*

Occurs in irregular masses, destitute of cleavage.

H.=2—2·5. G.=1·081. *Lustre* resinous. *Streak* white. *Color* yellow, sometimes reddish, brownish, and whitish. Transparent—translucent.

Composition, according to Drapier and Ure,

Carbon,	80·59	70·68
Hydrogen,	7·31	11·62
Oxygen,	6·73=94·63, D.	7·77=90·07, U.

Drapier also detected minute portions of lime, alumina, and silica. It burns readily with a yellow flame, emitting an agreeable odor, and leaves a black shining carbonaceous residue. It becomes electric by friction. Soluble in alcohol.

Obs. Amber occurs in the greatest abundance on the Prussian coast, in a bed of bituminous coal, whence it is washed out by the waves and thrown ashore. It is also obtained at the same place by sinking a shaft into the coal. It occurs also along the whole line of the Baltic coast, at Courland, Livonia, Pomerania, and in Denmark; also near Catania on the Sicilian coast, sometimes very peculiarly tinged blue. At Hasen Island in Greenland, it also occurs in brown coal; also near Paris in clay, and in China.

It has been often found in various parts of the green sand formation of the United States, either loosely imbedded in the soil, or engaged in marl or lignite, as at Gay Head or Martha's Vineyard, near Trenton, and also at Camden in New Jersey, and at Cape Sable, near Magothy river in Maryland.

The vegetable origin of amber is now fully ascertained. This is inferred, both from its native situation with coal, and from the occurrence of insects encased in it. Of these insects, some appear evidently to have struggled after being entangled in the then viscous fluid, and occasionally a leg or wing is found some distance from the body, which had been detached in the struggle for escape; frequently also a wing or leg is found alone, which evidently the insect had broken off in its partially successful attempts to release itself.

Amber was early known by the ancients, and called ηλεκτρον, *electrum*, whence, on account of its electrical susceptibilities, we have derived our word *electricity*. It was called

by some Lyncurium, though this name was applied, as is supposed, also to another mineral of remarkable electrical properties; also Succinum, because of its supposed vegetable origin, as stated by Pliny, "quod arboris *succum*, prisci nostri credidere."

Amber is extensively employed for ornamental purposes, and large fine specimens are highly valued. In the royal museum at Berlin, there is a mass weighing 18 pounds. A mass has lately been found in the kingdom of Ava, India, which is nearly as large as a child's head. It is intersected in various directions by veins of crystallized carbonate of lime, from the thickness of paper to one twentieth of an inch.

It is employed for the manufacture of a varnish, and for obtaining succinic acid, which it affords at a low temperature.

FOSSIL COPAL. Succinum copallinum.

Resembles the resin copal in hardness, color, lustre, transparency, and difficult solubility in alcohol. Emits a resinous odor when broken.

Composition, according to Johnston, (Brewster's Jour. xiv, 87, 1839,) Carbon 85·408, hydrogen 11·787, oxygen 2·669, ashes 0·136=100. Volatilizes in the air by a gentle heat Slightly acted upon by alcohol.

Obs. Comes from the blue clay of Highgate Hill, near London, from whence it is called Highgate resin.

Another resin, resembling the fossil copal in external appearance, has been examined by Johnston, and found to consist of Carbon 85·133, hydrogen 10·853, ashes 3·256=99·242. It occurs in the form of flattened drops or coatings on calc spar, on the walls of a dyke of trap, at the old lead mine in Northumberland, called *Settling Stones*. *Color* pale yellow to deep red, with a pale green opalescence. G.=1·16 to 1·54. Hard, but brittle. Does not melt at 400° F., but burns in the flame of a candle with an empyreumatic odor. Insoluble in water, and nearly so in alcohol.

MIDDLETONITE.

J. F. W. Johnston, Brewster's Jour. xii, 261, (1838.)

In rounded masses, seldom larger than a pea, or in layers a sixteenth of an inch or less in thickness, between layers of coal.

Hard and brittle. G.=1·6. *Lustre* resinous. *Color* reddish-brown by reflected light, and deep red by transmitted. *Powder* light-brown. Transparent in small fragments. No taste or smell. Blackens on exposure.

Composition, according to Johnston, Carbon 86·437, hydrogen 8·007, oxygen 5·563=100·007. Not altered at 400° F.; on a red cinder, burns like resin. Boiled in alcohol, ether, and oil of turpentine, the liquid becomes yellow, but dissolves only a mere trace of the resin. Softens and melts in boiling nitric acid, with the emission of red fumes: a brown flocky precipitate falls on cooling. Soluble in cold concentrated sulphuric acid.

Obs. Occurs about the middle of the main coal or Haigh Moor seam, at the Middleton collieries, near Leeds; also at Newcastle.

SCHEERERITE. Steatus acicularis.

Prismatic Resinous-Naphthaline, *Koenlein*.

Occurs in loosely aggregated crystalline grains and folia; also in minute acicular crystals, deposited in small cavities in coal.

Soft. 0·65, Macaire Prinsep. *Lustre* pearly, or resinous; feebly shining. *Color* whitish or gray. Easily frangible. Tasteless.

Inodorous. *Feel* not greasy. At 111° F., according to M. Prinsep, it melts, and in the fused state resembles a fatty oil, and like it penetrates paper; these spots, however, may be removed by heat. On cooling, the mineral crystallizes in four-sided acicular crystals. Its boiling point is at 197½° F.

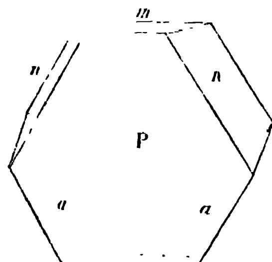
Composition, according to Prinsep, (Pogg. Ann. xv, 294,) Carbon 73, and hydrogen 24, nearly, and according to Kraus, (Pogg. xliii, 141,) Carbon 92·49, hydrogen 7·42. It takes fire easily, and is completely consumed, giving out much smoke and a feeble aromatic odor.

Obs. It was found by Capt. Scheerer, in the year 1822, in a bed of brown coal, near St. Gallen in Switzerland. These beds are from two to three feet thick, and appear to belong to a very recent formation.

The *Fichtelite* of Bromeis, from the brown coal of Uznach, is a similar substance, consisting of Carbon 89·3, hydrogen 10·7, and fusing at 115° F. The *Könlite* of Kraus, from the same locality, is said to consist of equal portions of carbon and hydrogen, and to fuse at 230° F.

HARTITE. Steatus obliquus.

Haidinger, Pogg. liv, 261.



Primary form, an oblique rhombic prism, (fig. 91, Plate II;) angle of prism about 100°. *Secondary* the annexed figure. P : a=about 120°. *Cleavage* only in traces.

H.=1. G.=1·046. *Lustre* somewhat greasy. *Color* white. Translucent.

Composition, according to Schrötter, Carbon 87·473, hydrogen 12·048. Fuses at 133° F., to a clear fluid.

Obs. Hartite resembles wax in translucency and in general appearance. It is allied to Scheererite, from which it is distinguished by its crystallization and the temperature of fusion, as well as action before the blowpipe. It occurs at Oberhart in Austria.

IXOLYTE.

Ixolyt, *Haidinger*, Pogg. lvi, 345.

Amorphous. Occurs in seams in bituminous coal.

H.=1. G.=1·008. *Lustre* greasy. *Color* hyacinth-red. Pulverized in the fingers, it becomes ochre-yellow and yellowish-brown. Thin fragments subtranslucent. *Fracture* imperfect conchoidal in the purer varieties.

Softens at 169° F., but is still tenacious at 212° F.—whence the name, from ἰξός and λύω, *to dissolve*.

Obs. This species resembles closely the Hartite, but differs in the temperature of fusion and other characters. It occurs in a coal bed at Oberhart, near Gloggnitz.

HATCHETINE. Steatus sebaceus.

Mineral Tallow.

Crystallized and amorphous in thin laminæ, having the consistency of soft wax. G. at 60° F.=0·916. *Lustre* nacreous. *Color*

white, becoming black and opaque on long exposure. Transparent. Feel greasy.

Composition, according to Johnston, (Brewst. Jour. xii, 338, 1838,) Carbon 85·910, hydrogen 14·624=100·534. Melts at 115° F. Heated cautiously it distils over without change. Sparingly dissolves in boiling alcohol, and precipitates again on cooling. Cold ether dissolves a small quantity, and hot ether more largely; the solution on cooling coagulates into a mass of minute pearly fibres, from which the ether may be separated by agitation or compression.

Obs. Occurs with the iron ores of the coal measures in Glamorganshire, and in some of the midland counties of England. It was first observed by Conybeare. It is said to have been found on the coast of Finland.

OZOCERITE.

Like a resinous wax in consistency and translucency; structure sometimes foliated. *Color* brown or brownish-yellow by transmitted light; leek-green by reflected light. *Odor* weak bituminous.

Composition, according to Magnus, (Ann de Ch. et de Ph. lv,) Schrötter, (Bib. Univ. 1836,) and Johnston, (Brewster's J. xii, 389, 1838,)

	Moldavia.	Moldavia.	Urpeth.
Hydrogen,	15·15	13·787	14·06
Carbon,	85·75=100·90, M.	86·204=99·991, S.	86·80=100·86, J.

Fuses at 140° F., and boils at 250°. Distils without apparent decomposition. No change in the strong acids, and very little in hot concentrated alcohol. Cold ether dissolves about four fifths of the whole, which it deposits, on evaporation, in brown flocks, that melt at 102° F. to a yellowish-brown liquid.

Obs. Ozocerite was discovered by Meyer in a sandstone in Moldavia, in the vicinity of coal and rock salt. It also occurs near Vienna; also at the Urpeth colliery, New Castle, England. It is sometimes made into candles.

MINERAL CAOUTCHOUC. Bitumen flexile.

Elastic Bitumen.

Occurs in soft flexible masses.

G.=0·9053—1·233, the Derbyshire variety. *Lustre* resinous. *Color* blackish-brown, of various shades. Subtranslucent; sometimes presents a brilliant dark orange-red color by transmitted light. Flexible or elastic.

According to M. Henry, junior, (Ann. des Mines, xii, 269,) it contains

	English variety.	
Carbon,	52·25	58·26
Hydrogen,	7·50	4·89
Nitrogen,	0·15	0·10
Oxygen,	40·10=100	36·75=100

Johnston (Brewst. J. xiii, 22, 1838) obtained, by a more satisfactory analysis,

Carbon,	85·474	84·385	85·96
Hydrogen,	13·283	12·576	12·34,

showing that it is closely allied to ozocerite and Hatchetine. It takes fire readily, and burns with a lively yellow flame, giving out a bituminous odor.

Obs. This species was first observed in Derbyshire, in the forsaken lead mine of Odin, by Dr. Lister, in 1673, who called it a subterranean fungus, and was uncertain whether it belonged to the vegetable or mineral kingdom. In 1797, it was accurately described by Hatchett, in the Linnæan Transactions, iv, 146. It has since been found in a coal mine at Montrelais, at the depth of 230 feet; and, according to Hausmann, (Handbuch, iii,

273.) it occurs at Neufchatel, and in the island of Zante. It has also been met with in bituminous limestone at Woodbury, Conn.

RETINITE. Bitumen fragrans.

Retinasphaltum, *Hatchett*, Phil. Trans. 1804.

Occurs in roundish masses.

H.=1—2·5. G.=1·135, Hatchett. *Lustre* often earthy externally, but slightly resinous in the fracture. *Color* light-yellowish-brown, sometimes green, yellow, red, or striped. Subtransparent—opaque. *Fracture* conchoidal. Often flexible and elastic, when first dug up; but it loses this property on exposure.

Composition, according to Hatchett (Phil. Trans., 1804, p. 404) and Bucholz, (Schweigger's Jour. i, 293,)

Vegetable Resin.	55	Resin soluble in alcohol,	91
Bitumen,	41	Resin insoluble in alcohol,	9=100, B.
Earthy matter,	3=99, H.		

Johnston after drying it at 300° F., obtained, (Brewster's Jour. xii, 560, 1838,) Resin soluble in alcohol 59·32, insoluble organic matter 27·45, white ash 13·23=100. Retinite takes fire in a candle, and burns with a bright flame and fragrant odor. The insoluble matter, heated in a tube, blackens, and gives off an empyreumatic odor; at a red heat, it burns. The whole is soluble in alcohol, excepting an unctuous residue.

Obs. This species was first observed near Devonshire, by Dr. Milles, accompanying Bovey coal. It has since been met with near Helboa, in the county of Mansfield, at Wolchow in Moravia, and near Halle, in brown coal. The purer specimens often consist of alternating layers. The variety from Bovey Tracey has a dry earthy texture, while that from Wolchow is hard and resinous.

GUYAQUILLITE. Bitumen amarum.

Johnston, Brewster's Jour. xiii, (1838,) p. 329.

Amorphous—yields easily to the knife, and may be rubbed to powder. G.=1·092. *Color* pale yellow. *Lustre* not resinous, or imperfectly so.

Composition, according to Johnston, Carbon 76·665, hydrogen 8·174, oxygen 15·161=100. Slightly soluble in water, and largely in alcohol, forming a yellow solution, which is intensely bitter. Begins to melt at 157° F., but does not flow easily till near 212°. As it cools becomes viscid, and may be drawn into fine tenacious threads. Soluble in cold sulphuric acid, forming a dark reddish-brown solution. A few drops of ammonia put into the alcoholic solution, darken the color, and finally change it to dark brownish-red.

Obs. It is said to form an extensive deposit near Guyaquil in South America.

The *Berengelite* of Prof. Johnston is closely similar to Guyaquillite, and an analysis by him gave Carbon 72·472, hydrogen 9·198, oxygen 18·330=100. Forms a bitter solution with cold alcohol. On evaporation, the resin obtained has a clear red color, and remains soft and viscid at the ordinary temperature. Fracture and lustre resinous. Color dark brown, with a tinge of green Powder yellow. Odor resinous, disagreeable. Taste a little bitter. It is said to form a lake, like that of Trinidad, in the province of St. Juan de Berengela, about one hundred miles from Arica, Peru, and is used at Arica for paying boats and vessels.

BITUMEN. Bitumen communis.

Black Mineral-Resin, *M.* and *J.* Mineral Oil, Naphtha, Petroleum, Mineral Pitch. Asphaltum. Bergpech, Bergtheer, *Haus.* Asphalt, *L.* Bitume, *H.*

Occurs both solid and fluid, presenting no regular form.

H.=0—2. G.=0·8—1·2. *Lustre* resinous. *Streak* commonly similar to the color. *Color* black, brown, and reddish; fluid varieties nearly colorless and transparent. *Fracture* of solid varieties perfectly conchoidal and brilliant. Sectile. Odor bituminous.

Naphtha (the fluid variety) contains, according to Thomson,

Carbon,	82·2
Hydrogen,	14·8=97

Inflames readily, and burns with much smoke.

Obs. The solid varieties of this species have been termed *mineral pitch*, or *asphaltum*; the fluid, *mineral oil*. The *earthy* and *slaggy* mineral pitch are two varieties of solid bitumen; the former is distinguished from the latter by its less conchoidal fracture. *Petroleum* is a fluid bitumen, which oozes from certain rocks of the coal formation, and becomes solid on exposure. *Naphtha* is a limpid or yellowish fluid; but when exposed to the air it deepens in color, and increases in consistency, till gradually it assumes the characters and appearance of petroleum. Naphtha may again be obtained from petroleum by heat.

Asphaltum is met with abundantly on the shores of the Dead Sea; in reniform stalactitic masses at Matlock in Derbyshire; in granite, with quartz and fluor, at Poldice, in Cornwall; in cavities of Chalcedony and calc spar, in Russia, and other places. Naphtha issues from the earth in large quantities in Persia and the Birman empire; at Rangoon there are upwards of five hundred naphtha wells, which afford annually 412,000 hhds. A very remarkable locality of bitumen occurs on the island of Trinidad, where there is a lake of it, one and a half miles in circumference. The bitumen is solid and cold near the shores, but gradually increases in temperature and softness towards the centre, where it is boiling. The appearance of the solidified bitumen is as if the whole surface had boiled up in large bubbles, and then suddenly cooled. The ascent to the lake from the sea, a distance of three quarters of a mile, is covered with the hardened pitch, on which trees and vegetation flourish, and here and there about Point La Braye the masses of pitch look like black rocks among the foliage.

Petroleum is met with in many parts of the United States. Kenhawa in Virginia, Scotsville, Ky., Duck Creek in Monroe Co., Ohio, Liverpool, Ohio, are among its localities. In New York it is found floating on the surface of Seneca lake, and is hence called *Genesee* or *Seneca* oil.

Naphtha affords both fuel and lights to the inhabitants of Badku, on the Caspian. It is also employed in Persia, and the Birman empire, as a lotion in cutaneous eruptions, and as an embrocation in bruises and rheumatic affections. It is employed for various purposes in the arts, particularly in the manufacture of varnish, and as a substitute for oil in the formation of oil paint, it being preferred on account of its rapid evaporation and drying.

Bitumen, in all its varieties, was well known to the ancients. It is reported to have been employed in the construction of the walls of Babylon, and at Agrigentum it was burnt in lamps, and called Sicilian oil. The Egyptians also made use of it in embalming. Two ship loads of the Trinidad pitch were sent to England by Admiral Cochran, but it was found that the oil required to render it fit for use, exceeded in expense the cost of pitch in England, in consequence of which, the project of employing it in the arts was abandoned.

IDRIALIN.

Massive, with greasy lustre, a grayish or brownish-black color, and a blackish streak inclined to red. Opaque.

Composition, according to Dumas, Carbon 94·9, hydrogen 5·1=100. Insoluble in water, and little so in alcohol or ether. Fuses at 400° F.

Obs. Occurs mixed with cinnabar at Idria. It is sometimes called, from its combustibility, *quecksilberbranderz*, or *inflammable cinnabar*.

ORDER II.—ANTHRACINEA.

BITUMINOUS COAL. ANTHRAX BITUMINOSUS.

Bituminous Mineral Coal, *M.* Common Coal. Brown Coal. Black Coal. Cherry Coal. Splint Coal. Cannel Coal. Jet. Lignite. Braunkohle. Pechkohle. Blätterkohle. Bituminöses Holz. Houille. Jayet, *H.*

Presents no regular form or structure.

H.=1—2·5. G.=1·2—1·5. *Lustre* more or less resinous. *Streak* and *color* black, or brown; often grayish, when impure. Opaque. *Fracture* conchoidal—uneven. Brittle, or sectile.

This species comprehends several varieties.

Pitch, or *caking coal*, when heated, at first breaks into numerous small pieces, which, on raising the heat, unite in a solid mass. Its color is velvet-black, or grayish-black. Specific gravity 1·269. It takes fire readily, and burns with a lively yellow flame, but requires frequent stirring to prevent its caking, which prevents the ingress of air for combustion. The principal beds at Newcastle afford this kind of coal. It contains, according to Thomson, (abstracting the earthy matter,) Carbon 24·75, hydrogen 1·375, nitrogen 5·25, and oxygen 1·5.

Cherry coal has much the appearance of caking coal, but is devoid of the property of softening and caking, when heated. It is very frangible, and hence, in mining it, there is considerable waste. Near Birmingham, the loss in mining, including the pillars, amounts to two thirds of the whole. G.=1·265. It burns more rapidly than caking coal, with a clear yellow flame. The combustible part contains, according to Thomson, Carbon 25·5, hydrogen 4·25, nitrogen 3·5, oxygen 1. It leaves about ten per cent. of ashes. It occurs at the Glasgow coal beds, and received its name from its lustre and beauty.

The *splint coal* from the same region is much harder than the cherry coal, and is hence sometimes called *hard coal*. It contains, besides 9·5 per cent. of earthy matter, Carbon 21, hydrogen 1·75, nitrogen 1·75, oxygen 3·5.

Cannel coal has a dark grayish-black or brownish-black color, a large conchoidal fracture, and receives a good polish. It takes fire readily, and burns without melting, with a clear yellow flame. On this account it has been used as a substitute for candles, and hence received its name. This coal contains, on an average, about 11 per cent. of earthy matter. The combustible part, according to Thomson, consists of Carbon 8·25, hydrogen 2·75, nitrogen 1·75. It abounds at Lesmahago, about twenty miles from Glasgow, also in different parts of Ayrshire, where it is made into inkstands, snuff-boxes, and other similar articles. *Jet* resembles cannel coal, but is blacker, and has a more brilliant lustre. It occurs in detached pieces in clay, on the coast near Whitby in Yorkshire, and at Ballard Point, and elsewhere. It is the *Gagates* of Dioscorides and Pliny, a name derived from the river Gagas in Syria, near the mouth of which it was found.

Wood coal, or *lignite*, occurs in the newest formations, and has all the structure and appearance of carbonized wood.

The Newcastle coal mines are stated to employ sixty thousand men. The principal coal mines of France are those of St. Etienne, Mons, Charleroi, and Liege. Germany is not rich in coal mines. The only deposits in Sweden occur at Höganes, near Helsinborg in Scania. Norway, Denmark, and Russia, seem to be entirely destitute of coal beds. Some trifling quantities are found in the Appennines in Italy. In Spain, coal occurs in Andalusia, Arragon, Estremadura, Catalonia, Castile, and the Asturias, but in quantities of little importance. The only coal bed in Portugal which is worked, is situated in the province

of Beira. Coal is also abundant in China and Japan, in the island of Madagascar, in Africa, and New Holland. But nowhere are its deposits more extensive and numerous than in the United States. It occurs extensively throughout the middle and western States.

ANTHRACITE. Anthrax lapideus.

Non-bituminous Mineral Coal, *M.* Glance Coal. Mineral Carbon. Blind Coal. Columnar Coal. Kilkenny Coal. Stangenkohle. Glanzkohle, *W.* Anthrazit, *Haus.* Kohlenblende, *L.* Anthracite, *H.*

It presents no regular structure.

H.=2—2·5. G.=1·3—1·6; 1·52—1·55, Pennsylvania coal; 1·75, Rhode Island coal. *Lustre* submetallic. *Streak* and *color* iron-black, sometimes grayish-black; often beautifully iridescent. Opaque. *Fracture* conchoidal.

It consists of nearly pure carbon.

The following compositions of specimens from Lehigh, Penn., and from Rhode Island, were obtained by Vanuxem, (Journal of the Acad. Nat. Sc. of Philad., v. 17:)

	Pennsylvania.	Rhode Island.	
Carbon,	90·1	90·03	77·70
Water,	6·6	4·90	6·70
Silica,	1·2	2·14	8·50
Alumina,	1·1	—	trace
Oxyd of iron and mang.	0·2=99·2	2·50=99·57	7·10=100

It burns with very little flame, and no smoke or bituminous odor.

Obs. Anthracite occurs principally in secondary rocks; but has been occasionally observed in more ancient strata.

It occurs at Kongsberg in Norway; in the trap of the Calton Hill, Edinburgh; at Kilkenny in Ireland, and in several parts of Wales, where it is called *Welsh culm.*

Extensive deposits of anthracite occur in Luzerne Co., Penn., in the anthracite region, as it is called, on the Susquehannah. Its length is between sixty and seventy miles, and breadth five miles, and it forms a kind of basin, through which pass the Susquehannah river and Lackawanna creek. The coal occurs throughout this region, cropping out of the hills and appearing on their sides, and the beds being nearly horizontal, they are worked without much downward excavation. The layers of pure coal are sometimes twenty or twenty-five feet thick, and the excavations appear like immense caverns, whose roofs are supported by enormous columns of coal, and "into which a coach and six might be driven and turned again with ease." For a particular account of these magnificent deposits, reference may be made to a valuable article on this subject, by Prof. Silliman, vol. xviii, p. 308, of the Amer. Jour. of Sc. The adjoining counties of Schuylkill and Lehigh, also abound in this variety of coal. A variety is found also at Portsmouth, Rhode Island; and at Worcester and Mansfield, Mass.

Anthracite is now very generally employed as fuel, in the eastern and northern parts of the United States.

GRAPHITE. Plumbago scriptoria.

Rhomboidal Graphite, *J.* Black Lead. Plumbago. Carburet of Iron.

Primary form, a rhombohedron. *Secondary form:* flat six-sided tables, having their basal planes striated parallel to the alternate edges. *Cleavage* parallel with the base of the prism perfect. Commonly in imbedded, foliated, or granular masses.

H.=1—2. G.=2·0891. *Lustre* metallic. *Streak* black and shining. *Color* iron-black—dark steel-gray. Opaque. Sectile; soils paper. Thin laminæ flexible. *Feel* greasy.

It is composed of carbon and a variable quantity of iron, which, according to Thomson, is mechanically mixed with the carbon. The following are a few of the analyses:

	Scheele.	Berthollet.	Vauquelin.	Saussure.		Vanuxem.
Carbon,	81	90·0	92	96		94·4
Iron,	10	9·1	8	4	Oxyd of iron,	1·4
Oxygen,	9=100	—=99·1	—=100	—=100	Silica,	2·6=98·4

At a high temperature it burns without flame or smoke, and leaves a portion of red oxyd of iron. It is infusible before the blowpipe both alone and with reagents. It is also unaffected by acids.

Obs. Graphite occurs in beds and imbedded masses in granite, gneiss, mica slate, primitive limestone, and gray-wacke, and is often connected with deposits of coal. It is also met with in greenstone.

A remarkably fine variety of graphite occurs at Borrowdale in Cumberland in nests in a greenstone rock which constitutes a bed in clay slate. In Glenstrathfarrar in Invernesshire, it forms nests in gneiss, and is associated with garnet. At Arendal in Norway, it is found in quartz. At Craignan in Ayrshire, it occurs in coal beds, and is situated in a layer of coal between two layers of greenstone. It is mixed with anthracite, and forms a bed from three to six feet thick.

Foliated masses of graphite occur near Ticonderoga, on Lake George, upon Roger's Rock, associated with pyroxene and sphene. Near Amity, Orange Co., N. Y., it is met with in white limestone, accompanying spinel, Brucite, hornblende, &c.; also in Bucks Co., Penn., three miles from Attleboro', associated with tabular spar, pyroxene, and scapolite; and one and a half miles from this locality, it occurs in abundance in syenite, at Mansell's black lead mine. Graphite is disseminated in large masses forming veins, in gneiss, at Sturbridge, Mass., where it presents a structure between scaly and fine granular, and an occasional approximation to distinct crystallizations; extensively in Cornwall, near the Housatonic, Ct.; at Greenville, L. C., associated with sphene and tabular spar, in primitive limestone; at Rossie, St. Lawrence Co., N. Y., with iron ore, and in gneiss.

Graphite is extensively employed in the manufacture of pencils. For this purpose it should be perfectly pure, and also of a granular structure. In the manufacture of lead pencils, it is sawn into thin slices and inserted into grooved semicylindrical pieces of wood, which are afterwards united by glue. The powder formed in the process of sawing is mingled with sulphur and gum, and employed in the manufacture of an inferior pencil. It is also a good material for crucibles, on account of its extreme infusibility. Varieties which are too impure for pencils, are well adapted for the manufacture of these articles. It is also used in polishing cast iron grates, stoves, &c., and for diminishing friction in heavy machinery.

The name *black lead*, often applied to this species, is entirely inappropriate, as it does not contain the least trace of lead.

The name of this species, graphite, is derived from γραφω, *I write*, in allusion to its extensive use as a material for writing, arising from its property of leaving a trace on paper.

SUPPLEMENT.

ANTRIMOLITE.

In white fibrous, silky stalactites, about as large as the finger, hanging in cavities in amygdaloid. The stalactites often contain a central nucleus of calc spar. H.=3·75. G.=2·096.

Composition, according to Thomson, (Min. i, 326,) Silica 43·47, alumina 30·26, lime 7·50, potash 4·10, protoxyd of iron 0·19, chlorine 0·098, water 15·32. Before the blowpipe forms an enamel without intumescence. Gelatinizes with muriatic acid.

Occurs in Antrim, Ireland, near the Giant's Causeway.

ARSENO-SIDERITE.

Forms fibrous concretions of a yellowish-brown color, at a manganese bed at Romanêche, in the department of Saone et Loire, France. The fibres are large and easily separate between the fingers, and when rubbed in a mortar the powder adheres to the pestle. G.=3·520.

Composition, according to Dufrênoy, Arsenic acid 34·26, peroxyd of iron 41·31, peroxyd of manganese 1·29, lime 8·43, silica 4·01, potassa 0·76, water 8·75. Fuses easily to a black enamel, giving off a feeble arsenical odor on adding soda. (*Dufrênoy*, Ann. des Mines, 4th ser. ii, 343, 1842.)

AUGITE AND HORNBLENDE PSEUDOMORPHS.

Rammelsberg gives the following for the composition of two varieties of altered augite crystals, (Pogg. xlix, 387;) *one* a yellow earthy specimen from Bilin, the *other* white crystals, a little yellowish or reddish, from Vesuvius: and from Beck we cite two analyses of hornblende pseudomorphs, (Min. N. Y., 307, 308;) the *first* in six-sided prisms, (resembling fig. 2 of hornblende,) with a soapy feel, and so soft as to be easily cut with a knife; the *second* in long slender prisms, with a hardness scarcely exceeding talc, and sometimes a little translucent.

	Bilin.	Vesuvius.	Warwick, N. Y.	Warwick, N. Y.
Silicia,	60·626	85·34	35·00	34·66
Alumina,	23·085	1·58	32·33	25·33
Peroxyd of iron,	4·207	1·67	——	——
Lime,	1·275	2·66	10·80	5·09
Magnesia,	0·910	1·70	20·70	25·22
Water,	9·124	5·47		9·09
	99·227, R	98·42, R.	98·83; B.	99·39, B.

The Warwick specimens were both from magnesian limestone.

The Rensselaerite, another variety of altered augite, (steatitic-pyroxene,) has been noticed under *Pyroxene*. The analysis of the Sahla steatitic-pyroxene there given, is by *Rose*, and not Beudant.

BAMLITE.

Columnar, with a white or grayish-white color, translucent, and an uneven splintery fracture. H.=6. G.=2·984.

Composition, Silica, 56·90, alumina 40·73, peroxyd of iron 1·04, lime 1·04, fluorine, *a trace*. From the Bamle in Norway. (*Erdmann*, J. f. pr. Chem. xxii, 1, 1841.)

BERAUNITE.

Radiated and massive, with one perfect and one imperfect cleavage. H.=2—2·5. G.=2·878. Lustre of cleavage face pearly; of other surfaces vitreous. Streak reddish ochre-yellow. Color hyacinth-red, becoming darker on exposure. In thin splinters a fine hyacinth-red translucence.

According to Plattner, Beraunite is a basic phosphate of the peroxyd of iron, containing water. It occurs with kakoxene at Hrbeck, near Beraun in Bohemia. (*Breithaupt*, J. f. pr. Chem. xx, 66.)

BERZELINE.

In minute white crystals, slightly translucent, and having a vitreous lustre on the surface of fracture, accompanying black garnet in an augitic rock, near La Ricia, in the Roman States.

Fuses with difficulty to a pale glass. With acids forms a jelly. (*Necker de Saussure*, Leonh. Jahrb. ii, 441.)

BEUDANTITE.

Primary an obtuse rhombohedron; R : R=92° 30′. Secondary form, the primary with the vertical angle truncated, fig. 13, Pl. II. Cleavage basal. H.=4—4·5. Lustre resinous. Color black. Streak greenish-gray. Translucent in thin fragments, and deep brown by transmitted light.

Wollaston detected in it only the oxyd of lead and iron.

Beudantite was found at Horhausen on the Rhine, and named by Levy in honor of F. S. Beudant. (Ann. Phil, N. S. xi, 194.)

BOLE.

Massive, and nearly impalpable. H.=1—2. G.=1·60, Klap.; 1·977, Breithaupt. Lustre weak. Color brown, yellowish, reddish. Streak shining and greasy. Subtranslucent—opaque. Feel greasy. Adheres to the tongue.

Composition, according to Löwig, (Leonh. Oryk.) Wackenroder, (Kastner's Archiv. xi, 466,) Zellner, (Leonh. N. Jahrb. 1835, 467,) and Rammelsberg, (Pogg. xlvii, 180,)

	Ettingshausen.	Cape de Prudelles.	Säsebuhl.	Striegau.	Stolpen.
Silica,	42·00	41·05	41·9	42·00	45·92
Alumina,	24·04	25·03	20·9	20·12	22·15
Peroxyd of iron,	10·03	8·09	12·2	8·53	trace
Lime,	0·52	0·15	——	2·81	3·90
Magnesia,	0·43	0·50	——	2·01	trace
Water,	24·03	24·02	24·9	24·00	25·86
	101·05, L.	99·14.	99·9, W.	99·47, Z.	97·83, R.

Hardens before the blowpipe and melts on charcoal, with intumescence, to a white or yellowish enamel.

Occurs in wacke and basalt, near Striegau in Silesia, at Habichtswald in Hesse, near Dransfeld, at Stolpen, and elsewhere.

Thomson's *Erinite*, from Antrim, Ireland, (Min. i, 341,) differs but little in composition from the bole of Stolpen.

The following are analyses of doubtful species, similar in appearance to the above, by Klaproth (Breit. iv, 345) and Kersten, (Schweig. J. lxxvi, 31:)

	Bolus, fr Sinope.	*Ochran*, (Br) fr. Orawitza.	*Fettbol*, fr. Halsbrück
Silica,	32·0	31·3	46·10
Alumina,	26·5	43·0	3·01
Peroxyd of iron,	21·0	1·2	23·50
Water,	17·0=96·5. Klap.	21·0=96·5. Kerst.	24·50=

The Bolus from Sinope contained also 1·5 of common salt, and that from Orawitza a trace of boracic acid.

Rock soap, or *bergseife*, is another compound allied to bole; Bucholz obtained for a specimen from Thuringia, (Gehlen's N. J. iii, 597,) Silica 44·0, alumina 26·5, peroxyd of iron 8·0, lime 0·5, water 20·5. An analysis by Berthier, of a variety from Plombières, gave a similar result. (Ann. des M. 3d ser. xi, 479.)

BYTOWNITE.

Amorphous, having a granular or imperfectly crystalline structure, and a light bluish shade of color. H.=6. G.=2·805.

Composition, according to Thomson, Silica 47·735, alumina 29·695, lime 8·800, peroxyd of iron 3·750, soda 7·600, magnesia *a trace*, water 2·00=99·580. From Bytown, Upper Canada. (Thom. Min. i.)

It appears to be nothing but scapolite.

CERIUM OCHRE.

Occurs as an incrustation of a sulphur-yellow color; pulverulent or in thin scales.

In an examination of one grain, Dr. C. T. Jackson obtained, Oxyds of cerium and lanthanum 0·2, yttria 0·1=0·3. Dr. J. considers it a hydrated yellow oxyd of cerium, containing some oxyd of uranium. Dissolves readily in muriatic acid, and forms a lemon-yellow solution. With borax, forms easily a transparent glass, orange-red while hot and pale delicate green when cold.

This ochre invests the pink scapolite of Bolton, Mass., or fills cavities in the rock. (*C. T. Jackson*, J. of Bost. Nat. Hist. Soc., Jan. 1844.)

CHONIKRITE.

Massive, of a white color, glistening lustre, and weak translucence.

Composition, according to Kobell, Silica 35·69, alumina 17·12, magnesia 22·50, lime 12·60, protoxyd of iron 1·46, water 9·00=98·37. Fuses with intumescence to a grayish glass. Dissolves in concentrated muriatic acid without gelatinizing. From Elba. (*v. Kobell*, Min. 215.)

Berzelius suggests that it is a mechanical mixture.

CHLORITOID.

Chloritspath, *Fiedler*. Pogg. xxv, 327. Barytophyllit, *Breit*.

Massive; foliated, curved or bent. H.=5·5. G.=3·55. Color greenish black.

Composition, according to Erdmann, (J. f. pr. Chem. vi, 89,) Silica 24·90, alumina 46·20, protoxyd of iron 28·89. Bonsdorff has analyzed the same mineral, collected at the locality by G. Rose, with the following result: Silica 27·48, alumina 35·57, protoxyd of iron 27·05, protoxyd of manganese 0·30, magnesia 4·29, water 6·95=101·64. (G. Rose's Reise nach dem Ural, i, 252; Jahresb. xviii, 233.) Infusible. After a long continued heat, becomes black and magnetic.

Occurs at Koroibrod in the Ural, associated with mica and kyanite.

The *Masonite* of Jackson has been appended to hornblende as an impure foliated variety of that species; yet in many of its characters, its hardness, specific gravity, and structure, it is very similar to chloritoid; and in composition it differs not very essentially from the chloritoid as analyzed by Bonsdorff. From the appearance of the Masonite, its opacity, and the dull cross fracture of its brittle folia, it probably contains impurities which throw some doubt upon conclusions drawn from the results of analysis.

CLUTHALITE.

A congeries of imperfect crystals forming nodules in amygdaloid. H.=3·5. G.=2·166. Lustre vitreous. Color flesh-red. Opaque or subtranslucent. Fragile.

Composition, according to Thomson, Silica 51·266, alumina 23·560, peroxyd of iron 7·306, soda 5·130, magnesia 1·233, water 10·553=99·048. From Dumbarton. (*Thomson*, Min. i, 339.)

CYMATINE.

The Cymatine, Metaxite, and Pyponite of Breithaupt, are fibrous minerals, occurring, the first in serpentine and the other two in granular limestone. The color of each is some shade of green, and they are all fusible before the blowpipe. (Schweig. J. lxiii, 276, 278, 279.)

Cymatine, according to Rammelsberg, is asbestus or fibrous tremolite. The other two are probably either asbestiform pyroxene or hornblende.

DANBURITE.

Imperfectly crystallized, presenting a honey-yellow color, vitreous lustre, hardness equal to 7·5, and specific gravity 2·83.

Composition, according to Shepard, Silica 56·00, lime 28·33, alumina 1·70, yttria? 0·85, potash (with soda?) and loss 5·12, water 8·00=100. Phosphoresces when heated. Occurs in feldspar with Dolomite at Danbury, Conn., the largest pieces not exceeding an inch in length. (*Shepard*, Sill. J. xxxv, 137.)

It is improbable that a hydrous silicate of lime should have the hardness here stated, so far above other allied compounds. The mineral appears to be a mechanical mixture of grains of quartz, sometimes detected with the naked eye, and a silicate of lime.

DELVAUXENE.

Massive and earthy, with a yellowish-brown color. H.=2·5. G.=1·85.

Composition, according to Dumont, (L'Institut, No. 276,) Phosphoric acid 13·60, peroxyd of iron 29·00, water 42·20, carbonate of lime 11·00, silica 3·00=99·40. Changes color before the blowpipe, and fuses to a gray magnetic globule.

From Berneaux in Belgium. It is supposed to be a mechanical mixture.

DREELITE. (p. 229.)

This mineral occurs in France, at Beaujeu in the department of the Rhone.

FAUJASITE.

Occurs in square octahedrons—having the angles 111° 30′ and 105° 30′. Scratches glass easily. G.=1·923. Lustre colorless—brown. Fracture vitreous and uneven.

Composition, according to Damour, (Ann. des M., 4th ser. i, 395,) Silica 49·36, alumina 16·77, lime 5·00, soda 4·34, water 22·19=97·96. Heated in a glass tube, gives out water. Before the blowpipe it intumesces and fuses to a white blebby enamel. In the platina forceps, with salt of phosphorus, it is easily dissolved. Soluble in muriatic acid.

Occurs with black augite in the mandelstein of Kaiserstuhl. It was named by Damour, in honor of Faujas de Saint Fond. The composition of this mineral allies it to the Zeolites.

GEDRITE.

Dufrenoy, Ann. des Mines, 3d ser. x, 582.

In crystalline masses having a fibrous, radiated or lamellar structure. H. not above 5. G.=3·26. Lustre submetallic, feeble. Color clove-brown. Streak gray or yellowish. Tough.

Composition, Silica 38·811, alumina 9·309, protoxyd of iron 45·834, magnesia 4·130, lime 0·666, water 2·301=100·051, (Dufrènoy.) Fuses readily to a black slightly scoriaceous enamel. Occurs in loose stones near Gèdre in the Pyrenees. It has some resemblance to anthophyllite and hypersthene.

G. Rose considers it an iron-epidote, and Rammelsberg suggests that it may be hypersthene.

GILBERTITE.

Con. In plates lying irregularly together. H.=2·75. G.=2·648. Lustre silky. Color white, slightly yellowish. Translucent. Sectile.

Composition, according to Lehunt, (Thom. Min. i, 235,) Silica 45·155, alumina 40·110, lime 4·170, magnesia 1·900, peroxyd of iron, 2·430, water 4·250=98·015.

Found at Cornwall in the lode of Stonagwyn, mixed with fluor spar. It was named by Thomson in honor of Davies Gilbert, Esq.

GLOTTALITE.

Primary form, monometric. Cleavage octahedral (?) H.=3·5. G.=2·18. Lustre vitreous. Color white. Translucent.

Composition, according to Thomson, Silica 37·014, alumina 16·308, lime 23·927, peroxyd of iron 0·500, water 21·250=98·999.

Fuses with intumescence to a white enamel.

Probably from the river Clyde in Scotland. (*Thomson*, Min. i, 328.)

GREEN EARTH. (Grünerde of the Germans.)

The name Green Earth is applied to different compounds, resembling one another in presenting a dark green color and nearly earthy appearance. Some are probably earthy forms of augite; others, impure silicates of iron. The green earth occupying cavities in trap rocks is usually referred to the species chlorite. It has a foliated, granular, or earthy texture, with the softness of chlorite, and its olive-green color. Klaproth obtained for the green earth from Mt. Baldo, (Beit. iv, 239,) Silica 53, peroxyd of iron 28, magnesia 2, potash 10, water 6=99; and for another from Lossossna in Prussia, Silica 51·00, peroxyd of iron 17·00, magnesia 3·50, soda 4·50, potash 9·00, alumina 12·00, lime 2·50=99·50.

Composition of the *Green Grains* of the green sand formation of Gay Head, according to Dr. S. L. Dana, (Hitchcock's Geol. of Mass., p. 93,) and of New Jersey, according to Prof. H. D. Rogers, (Geol. Rep. New Jersey, pp. 204 and 207,)

	Gay Head.	Cauley's pits, near Woodstown.	P. Scull's pits, near Sculltown.	Poke Hill, Burlington Co.
Silica,	56·700	48·45	51·50	50·75
Alumina,	13·320	6·30	6·40	6·50
Protox. of iron,	20·100	24·31	24·30	22·14
Potash,	——	12·01	9·96	12·96
Magnesia,	1·176	——	trace	——
Lime,	1·624	trace	——	——
Water,	——=99·920	8·40=99·47	7·70=99·86	7·50=99·85

Berthier obtained for the same from Germany, Silica 46·1, alumina 5·5, protoxyd of iron 19·6, magnesia 3·8, potash 5·3, water 8·9, quartz 11·5.

When first dug the grains are very soft, but on exposure they nearly equal gypsum in hardness.

A Green Earth pseudomorph,
forded Rammelsberg,
nesia 0·28, water 9·82,
of iron 15·66, magnesia 1·70, carb. lime 15·24, peroxyd of iron 8·94, alkali and water 8·67 =100. (Pogg. xlix, 387.)

The *Grengesite* of Breithaupt (Strahlige Grüneisenerde from Dalarne) has a specific gravity 3·1, a dark-green color, and a greenish, somewhat shining, streak. According to Hisinger it consists of Silica 27·01, protoxyd of iron 25·63, alumina 14·31, magnesia 14·31, oxyd of manganese 2·18, water 12·53.

The *Thuringite* of Breithaupt has an olive-green color, with a greenish shining streak, a pearly lustre, and massive granular structure, with a distinct cleavage in one direction. It occurs at an iron mine in Saalfeld. It appears to be allied to pinguite.

HAYDENITE.

On page 342 of this work, a figure of Haydenite is given, with its general physical characters. It has since been examined chemically by B. Silliman, Jr., with the following results:

H.=3. G.=2·136—2·265. Dissolves partially without gelatinizing in sulphuric acid, and on cooling deposits crystals of alum. Fuses with difficulty before the blowpipe—tinges the outer flame violet. Heated in a glass tube alone, it gives off a slight empyreumatic odor, and deposits water.

Composition, Silica 56·831, alumina 12·345, protoxyd of iron 8·035, potash 2·388, lime 8·419, magnesia 3·960, water 8·905=100·883.

Obs. This species resembles *Chabazite*, differing chiefly in containing only half the amount of water, a portion of magnesia, and in the substitution of iron for a part of the alumina, in which respect it resembles the *Acadiolite* of Jackson. (Private communication to the author.)

HERRERITE.

Massive; reniform. *Cleavage* in three directions, indicating a rhombohedral primary. Surface curved. H.=4—5. G.=4·3. Lustre vitreous to pearly; shining on fresh surfaces. Streak yellowish-gray. Color pistachio, emerald, and grass-green. Translucent.

Composition, according to Herrera, Carbonic Acid 31·86, tellurium 55·58, peroxyd of nickel 12·32, which, as Rammelsberg states, is an improbable compound. On charcoal, it becomes gray under the action of the blowpipe, and evolves a white smoke which adheres to the charcoal. In the reducing flame it is changed to a beautiful grass-green.

It occurs at Albarradon in Mexico, in transition limestones, in a metallic vein, consisting chiefly of ores of lead, native silver, horn silver, and iodic silver.

HUMBOLDTILITE.

On page 359 Mellilite has been annexed along with Somervillite to Gehlenite, as proposed by Breithaupt. More lately Mellilite has been analyzed by Damour and Descloiseaux, and found to be identical with Humboldtilite. Crystallized Gehlenite is, by these analyses, shown to differ from Humboldtilite, while the *massive* variety approximates to it. Kobell's analysis of massive Gehlenite is here added.

	Mellilite.	*Humboldtilite.*		*Massive Gehlenite.*
Silica,	39·27	40·69		39.80
Alumina,	6·42	4·43		12·80
Magnesia,	6·44	5·75		4·64
Lime,	32·47	31·81		37·64
Protoxyd of iron,	10·17	10·88	Peroxyd,	2·57
Potassa,	1·46	0·36		0·30
Soda,	1·95=98·18	4·43=98·35	Moisture,	2·00=99·75

(*MM. Damour and Descloiseaux*, Comptes Rendus, Nov. 1843—*V. Kobell*, Kast. Archiv, iv, 313.) V. Kobell considers Gehlenite a combination of a silicate and aluminate, and includes the crystallized and massive under the same chemical formula.

HURONITE.

In spheroidal masses; granular or with an imperfect cleavage. H.=3·25. G.=2·86. Lustre pearly to greasy. Color light yellowish-green. Streak gray. Translucent.

Composition, according to Thomson, Silica 45·80, alumina 33·92, protoxyd of iron 4·32, lime 8·04, magnesia 1·72, water 4·16=97·96. Infusible. Not attacked by acids. From the vicinity of Lake Huron. (*Thomson*, Min. i, 384.)

HYDROTALCITE.

A steatitic mineral from Snarum. *Composition*, according to Hochstetter, Magnesia 36·30, alumina 12·00, peroxyd of iron 6·90, carbonic acid 10·54, water 32·66, insoluble matters 1·20=99·60, according to which it is a hydrous aluminate of magnesia, with carbonate of magnesia. (J. f. pr. Chem. xxvii, 376.)

ILMENITE.

The *Washingtonite* of Shepard, a variety of Ilmenite, has been analyzed by J. S. Kendall in Dr. C. T. Jackson's laboratory and found to contain, Titanic acid 25·28, peroxyd of iron 51·84, protoxyd of iron 22·86=99·98. (Communicated by Dr. C. T. Jackson, to the author.) It appears therefore to be nearly identical in composition with the hystatic iron ore of Breithaupt, or the *Hystatite* variety of this species.

ISOPYRE.

Isopyric Quartz, *Haid.* Ed. New Phil. Jour. iii, 263.

In compact masses, without cleavage. H.=6—6·5. G.=2·9—3. Lustre vitreous. Streak light greenish-gray. Color grayish or velvet-black, occasionally spotted red, like heliotrope. Opaque—subtranslucent. Fracture flat conchoidal. Brittle. Acts slightly on the magnetic needle.

Composition, according to Dr. Turner, Silica 47·09, alumina 13·91, peroxyd of iron 20·07, lime 15·43, oxyd of copper 1·94=98·44. Fuses before the blowpipe without the emission of any gaseous matter. Acids act upon it with difficulty; it is easily and completely decomposed by alkaline carbonates.

Isopyre forms compact masses, occasionally two inches in diameter, in the granite of St. Just, near Penzance, where it is associated with tourmaline and tin. It much resembles obsidian, but was distinguished by Haidinger in consequence of its fainter and less vitreous lustre. The name *Isopyre* is derived from ἴσος, *equal*, and πυρ, *fire*, from the similarity of its comportment under the blowpipe to that of many other mineral species.

KILLINITE. (Page 305.)

Killinite comes from Killiney Bay, near Dublin, where it occurs in granite veins along with spodumene. It is probably nothing but spodumene, which has been somewhat altered and rendered hydrous by partial decomposition.

KIRWANITE.

Fibrous; fibres diverging from a centre. H.=2. G.=2·941. Color dark olive-green. Opaque.

Composition, according to R. D. Thomson, Silica 40·5, protoxyd of iron 23·91, lime 19·78, alumina 11·41, water 4·35=99·95. Blackens before the blowpipe and partially fuses. With soda or borax forms a dark brown glass. Occurs in basalt on the northeast coast of Ireland. (*Thomson*, Min. i, 379.)

KNEBELITE.

Massive, with an uneven and cellular surface, and quite hard. G.=3·71. Lustre glistening. Color gray, spotted dirty-white, red, brown, and green. Opaque. Brittle. Fracture subconchoidal.

Composition, according to Döbereiner, Silica 32·5, protoxyd of iron 32, protoxyd of manganese 35. Unaltered alone before the blowpipe. Fuses with borax to a dark olive-green pearl. Locality unknown. It was named by Döbereiner in honor of Major Von Knebel. (Schweig. Jour. xxi, 49.)

LAVENDULAN.

Amorphous with a greasy lustre, inclining to vitreous. H.=2·5—3. G.=3·014, Breithaupt. Color lavender-blue. Streak paler blue. Translucent.

Contains, according to Plattner, Arsenic and the oxyds of cobalt, nickel and copper, with water. Fuses easily before the blowpipe, coloring the flame deep blue, and yielding a globule which becomes crystalline on cooling. On charcoal yields an arsenical odor. With the fluxes gives the reaction of cobalt. Occurs at Annaberg in Saxony, with cobalt and iron ores. (*Breithaupt*, J. f. pr. Chem. x, 505.)

LIME MALACHITE.

The Lime Malachite (Kalk-Malachit) of Zinken is a green mineral from the Hartz, resembling copper froth. From Zinken's trials, it is a hydrous carbonate of copper, with carbonate and sulphate of lime, and some iron. (Berg- und hüttenm. Ztg. i, No. 24.)

MALTHACITE.

In thin plates and massive, with an uneven or conchoidal fracture. Soft like wax. G.=1·99—2·01. Lustre waxy, weak. Color white or yellowish. Streak shining. Translucent.

Composition, according to Meissner, Silica 50·2, alumina 10·7, lime 0·2, peroxyd of iron 3·1, water 35·8. Decrepitates a little and hardens before the blowpipe, giving out water, but does not fuse. With a cobalt solution becomes blue. Occurs at Steindörfel between Löbau and Bauzen, in basalt, and in greenstone near Beraun in Bohemia. (*Breithaupt*, J. f. pr. Chem. x, 510.)

MANCINITE.

A brown silicate of Zinc from Mancino near Leghorn. Plumose and shining, with two unequal cleavages inclined at an angle of 92° to one another. Analysis shows it to be a *simple silicate of zinc*. (*Jacquot*, Ann. des Mines, 3d ser., xix, 703.)

MESOLE. (p. 334.)

Mesole fuses easily before the blowpipe to a whitish glass, and gelatinizes easily and perfectly with the acids.

MOLYBDIC OCHRE.

An earthy yellow powder or incrustation. Composition, Oxygen 33·387, molybdenum 66·613. Fuses to a slag. With borax forms a colorless glass in the outer flame and a brown glass in the inner. Reduced with soda. Easily soluble in muriatic acid.

Dr. C. T. Jackson has detected a small portion of oxyd of uranium in the yellow oxyd of molybdenum from Westmoreland, N. H., and attributes its yellow color to this oxyd.

MONTICELLITE.

In small crystals; primary a rhombic prism of 132° 34′; cleavage not apparent. H.=5—7. Color yellowish or nearly colorless and transparent.

Fuses with difficulty before the blowpipe. Gelatinizes with muriatic acid. Occurs in granular limestone at Vesuvius, associated with particles of black mica and pyroxene. (*Brooke*, Annals of Phil. Oct. 1831.)

Breithaupt supposes it to be near olivine.

MOUNTAIN CORK.

The Mountain Cork (Bergholz) from Sterzing afforded Thaulow on analysis, Silica 55·506, peroxyd of iron 19·560, magnesia 14·410, lime 0·121, alumina, 0·041, water 10·358=99·996, a composition which appears to separate it from asbestus. (Pogg. xli, 635.)

NACRITE.

Resembles a soft earthy talc, consisting of minute grains or scales, having a pearly lustre and white color. Feel greasy. Different compounds presenting these characters are included under this name, and farther examination is required before they are satisfactorily understood. The following are the results of analyses by Vauquelin, Thomson, (Rec. Gen. Sci. May, 1836,) Schort, and Tennant, (Thom. Min. i, 244,)

	Alps.	Brunswick, Me.	Wicklow.		Wicklow
Silica,	50·0	64·440	16·000		44·55
Alumina,	26·0	28·844	35·200		33·80
Potash,	17·5	——	——	Magnesia,	3·30
Lime,	1·5	——	9·608		1·30
Peroxyd of iron,	5·0	Protox. 4·428	2·880		7·70
Protoxyd of mang.	——	——	3·944		·2·25
Water,	——	1·000	2·008		6·25
	100·0, V.	98·712, T.	99·632, S.		99·55, T

The last two are Thomson's *Talcite*; and occur in granite. Rammelsberg suggests that the nacrite analyzed by Vauquelin was mica.

NEWKIRKITE.

In minute square prisms. H.=3·5. G.=3·824. Lustre metallic. Color black.

Composition, according to Muir, oxyd of manganese 56·30, oxyd of iron 40·35, water 6·70=103·35. From Newkirk in Alsace. (*Thomson*, Min. i, 509.)

ONKOSIN.

Massive, in roundish pieces, having an apple-green color, sometimes grayish or brownish, and a weak greasy lustre. Translucent. H.=2. G.=2·8. Fracture fine splintery.

Composition, according to Kobell, Silica 52·52, alumina 30·88, magnesia 3·82, protoxyd of iron 0·80, potash 6·38, water 4·60=99·00. Fuses with intumescence to a white blebby glass. Soluble in sulphuric acid and not in muriatic. From Salzburg. (*Kobell*, J. f. pr. Chem. ii; 295.)

Berzelius is disposed to consider it a mechanical mixture.

OTTRELITE.

In small rounded brilliant plates, with a perfect basal cleavage, a grayish or greenish-black color and a pale green streak. Scratches glass with difficulty. G.=4·40. Fracture uneven.

Composition, according to Damour, Silica 43·34, alumina 24·63, protoxyd of iron 16·72, protoxyd of manganese 8·18, water 5·66=98·53. Fuses with difficulty to a black magnetic globule. Occurs near Ottrez, on the borders of Luxembourg, in argillaceous schist. (Ann. des Mines, 2d ser. ii, p. 357.)

PELOKONITE.

Massive, with a weak vitreous lustre, bluish-black color, and liver-brown streak. H.=3. G.=2·567. Opaque. Fracture conchoidal.

Contains oxyds of iron and manganese, and some copper. Forms a pistachio-green solution with muriatic acid. Occurs in Chili with malachite and chrysocolla. The name Pelokonite is from πελος, *brown*, and κονις, *powder*, in allusion to the color of the streak, which distinguishes it from cupreous manganese. (*Richter*, Pogg. xxi, 591; *Kersten*, Schweig. J. lxvi, 7.)

PHILLIPSITE. (Page 332.)

Phillipsite fuses before the blowpipe with some intumescence, and gelatinizes with muriatic acid.

PHYLLITE.

A micaceous mineral in small black scales from Sterling, Mass., analyzed by Dr. Thomson with the following result: Silica 38·40, alumina 23·68, peroxyd of iron 17·52, magnesia 8·96, potash 6·80, water 4·80=100·16. (Ann. Lyc. Nat. Hist. N. Y. iii.)

It appears to be allied to Soltmann's Lepidomelane, and to Ottrelite above.

PIGOTITE.

Massive, of a brownish color, and affording a yellow powder. Insoluble in water and alcohol. Burns with difficulty, leaving an ash consisting mostly of alumina.

According to Johnston, it consists of an organic acid, which he calls mudescous acid, combined with alumina. It forms an incrustation on the granite walls of a cavern in Cornwall. (*Johnston*, Phil. Mag. xvii, 382, 1840.)

PIMELITE.

Pimelite is an apple-green earth or clay, colored by oxyd of nickel, of which Klaproth found 15·63 per cent. in one specimen, (Beit. ii, 134.) It is often associated with chrysoprase or green quartz.

POLYHYDRITE.

Polyhydrite is a silicate of the peroxyd of iron from Schwartzenberg, of a liver-brown color, resinous lustre, and opaque. G.=2·1—2·142. It contains 29·2 per cent. of water. (*Breithaupt*, J. f. pr. Chem. xv, 321.)

PORCELAIN SPAR.

In square prisms, (a rhombic of 92°?) Cleavage diagonal, rather imperfect. H.=5·5. G.=2·65—2·68. Lustre of a cleavage face pearly. Color white or yellowish-white. Translucent to subtranslucent.

Composition, according to Fuchs, Silica 49·30, alumina 27·90, lime 14·42, soda 5·46, water 0·90. Fuses easily to a colorless blebby glass. Dissolves in concentrated muriatic acid without gelatinizing.

Occurs in granular feldspar at Obernzell in Bayern. It is allied to Wernerite, a variety of scapolite.

PRASEOLITE.

Imperfectly crystallized, apparently in prisms of 4, 6, 8 or 12 sides, with the edges rounded. Cleavage in one direction. H.=3·5. G.=2·754. Lustre weak. Color light or dark green. Streak clear green. Fracture splintery and flat conchoidal.

Composition, according to Erdmann, Silica 40·94, alumina 28·79, protoxyd of iron 6·96, protoxyd of manganese 0·32, magnesia 13·73, water 7·38, titanic acid 0·40, oxyds of lead, copper, and cobalt, with lime 0·50=100·40. Fuses with difficulty on the thinnest edges to a bluish-green glass. With borax forms an iron-colored globule. Occurs near Brevig, Norway, in granite, along with chlorite, titanic acid, and tourmaline. (*Erdmann*, K. V. Ac. Handl. 1840.)

PYROSCLERITE.

Primary a rhombic prism with one perfect cleavage, and another at right angles with this, imperfect. H.=3. G.=2·74. Lustre weak pearly. Color green, apple-green, grayish-green. Translucent. Fracture uneven and splintery.

Composition, according to Kobell, (Min. 215,) Silica 37·03, alumina 13·50, oxyd of chromium 1·43, magnesia 31·62, protoxyd of iron 3·52, water 11·00=98·10. Fuses with some difficulty to a grayish glass. Occurs at Elba and at Aker in Südermanland.

PYRRHITE.

Primary form the regular octahedron. Cleavage not observed. H.=6. Lustre weak vitreous. Color orange-yellow. Subtranslucent.

Infusible. Small splinters blacken and color the flame deep yellow. Pulverized it dissolves easily in borax or salt of phosphorus; adding largely of the fluxes, it forms a clear glass, which has a yellowish-green color when cold; with less, the glass remains colorless.

Pyrrhite was found by Von Perovski of St. Petersburg, at Alabaschka, near Mursinsk,

where it occurs in drusy feldspar cavities, containing also tables of lithia-mica, crystals of albite, and a single crystal of white topaz. The largest crystal was but three lines long. The name is from πυρρος, *yellow*. (*G. Rose*, Pogg. xlviii, 562.)

RAPHILITE.

In diverging acicular crystals, white or tinged with bluish-green and between glassy and silky in lustre. H.=3·75. G.=2·85.

Composition, according to Thomson, Silica 56·478, lime 14·750, alumina 6·160, protoxyd of iron 5·389, protoxyd of manganese 0·447, magnesia 5·451, potash 10·533, moisture 0·50=99·708. The fibres become opaque and are rounded before the blowpipe. From Perth, Upper Canada. (*Thomson*, Min. i, 153.)

Raphilite appears to be a fibrous hornblende allied to Arfvedsonite, or perhaps impure from admixture with feldspar.

SCAPOLITE.

The pink Scapolite of Bolton, Mass., consists of Silica 45·940, alumina 28·840, lime 14·632, soda 5·430, lithia 1·580, potash 0·640, magnesia 0·208, oxyd of cerium and lanthanum 2·000, water 0·500=99·770. H.=5·75. G.=2·7138. (*C. T. Jackson*, Bost. Nat. Hist. J., Jan. 1844.)

SCHRÖTTERITE.

Resembles allophane, and has been called opal allophane, (opalin-allophan.) Composition, according to Schrötter, Silica 11·950, alumina 46·300, water 36·200, peroxyd of iron 2·950, lime 1·298, oxyd of copper 0·250, sulphuric acid 0·780=99·728. Before the blowpipe, it acts like allophane, but becomes white. From Steyermark. (Baumgartner's *Zeitsch.* 1837, also J. f. pr. Chem. xi, 380.)

SORDAWALITE.

Norkenskiöld's Bidrag, p. 86.

Massive; no cleavage apparent. H.=2·5—3. G.=2·53—2·58. Lustre vitreous. Streak liver-brown. Color grayish or bluish-black. Opaque. Fracture conchoidal. Brittle.

It contains, according to Nordenskiöld, Silica 49·4, alumina 13·8, protoxyd of iron 18·17, magnesia 10·67, phosphoric acid 2·68, water 4·38=99·10. Before the blowpipe, alone, it is difficultly fusible to a blackish globule. With borax it forms a green glass. Partly soluble in muriatic acid. Becomes reddish on exposure to the atmosphere.

Forms thin layers on trap, near the town of Sordawala in Finland; at Bodenmais in Bavaria, it is associated with magnetic pyrites. It resembles pit-coal in appearance.

STEINMANNITE.

Primary form, the cube. Cleavage cubic; also massive. H.=2·5. G.=6·83. Lustre metallic. Color lead-gray. Fracture uneven.

Composition yet undetermined. On charcoal, fumes of sulphurous acid and antimony are given off, and finally a globule of lead is obtained, which contains silver.

Occurs at Przibram. According to Zippe, the so-called *Bleischweif* of the Germans is a mixture of this species and galena.

STILPNOMELANE.

Foliated, and also compact. H.=3: G.=3—3·4. Lustre of cleavage surface between vitreous and pearly. Color black. Streak greenish.

Composition, according to Rammelsberg, Silica 46·167, protoxyd of iron 35·823, alumina 5·879, magnesia 2·666, potash with a trace of soda 0·750, water 8·715=100. Fuses with some difficulty to a black shining globule.

Occurs at Obergrund, with calc spar and quartz, sometimes intermixed with pyrites and magnetic iron ore. (Pogg. xliii, 127.) It is thought by Berzelius to be a mechanical mixture.

SYMPLESITE.

Symplesit, *Breithaupt.* J. f. prakt. Chemie, x, 501.

Primary form, a right rhomboidal prism, resembling cobalt bloom. Cleavage perfect parallel with the larger lateral face.

H.=2·5, nearly. G.=2·957. Lustre of cleavage face pearly. Color pale indigo, inclined to celandine-green; sometimes between leek and mountain-green. Subtransparent to translucent.

Supposed to be an arsenate of the protoxyd of iron. Heated in a glass tube, it turns brown, and loses 25 per cent. of water. On charcoal, it gives off an alliaceous odor, turns black without melting, and is then magnetic.

Occurs at Lobenstein in Voigtland, with cobaltic pyrites and dolomite.

TACHYLITE.

Massive, or in plates. No cleavage. H.=6·5. G.=2·5—2·54. Lustre vitreous to greasy. Color velvet-brown—black. Opaque. Fracture small conchoidal.

Composition, according to Gmelin, of the variety from the Vogelsgebirge, Silica 50·220, titanic acid 1·415, alumina 17·839, lime 8·247, soda 5·185, potash 3·866, magnesia 3·374, protoxyd of iron 10·266, protoxyd of manganese 0·397, ammoniacal water 0·497=101·306. Melts easily before the blowpipe, with intumescence to a brown slag or opaque glass.

Occurs at Saesbühl in basalt and wacke. It resembles obsidian or Gadolinite in external characters. It has also been observed at Vogelsgebirge; sp. gr. of this variety 2·7144. (*Breithaupt*, Kastner's Archiv, vii, 112. *Gmelin*, Pogg. xlix, 233.)

TERENITE.

Emmons, Communication relative to a Geolog. Survey of New York, 1837.

Cleavage parallel to the sides and diagonals of a right square prism. H.=2. G.=2·53. Lustre faint, pearly. Color yellowish-white, or pale yellowish-green. Fragile.

In the exterior flame of the blowpipe it is immediately converted into a white enamel; in the interior, it fuses with ebullition to a porous glass. With nitrate of cobalt, the enamel assumes a lively blue color.

It occurs in a vein about an inch wide, traversing granular carbonate of lime, in Antwerp, St. Lawrence Co., N. Y. Its name alludes to its characteristic fragility, and is derived from the Greek τερην, *tender*. It may be a half decomposed scapolite.

THROMBOLITE.

An amorphous green phosphate of copper from Retzbanya, in Hungary.

Composition, according to Plattner, Oxyd of copper 39·2, phosphoric acid 41·0, water 16·8=97·0. It colors the flame blue, and then green. On charcoal, fuses easily to a black globule, and finally yields a bead of copper. With boracic acid and iron, gives the reaction of phosphoric acid. *Breithaupt*, (J. f. pr. Ch. xv, 321.)

VARISCITE.

Variscit, *Breithaupt*, Jour. f. pr. Chem. x, 506.

In reniform masses. H.=5. G.=2·345—2·379, *Breit.* Lustre greasy, weak. Color apple-green. Streak white, shining, Translucent.

According to Plattner's trials it consists principally of phosphoric acid and alumina, with some ammonia, magnesia, protoxyd of iron, oxyd of chrome, and water. In a glass tube it gives off water, which is alkaline in its reaction, and becomes faintly rose-red. By itself it is infusible. With borax it forms easily a clear yellowish-green glass.

Variscite occurs in quartz and siliceous slate at Massbach in Voigtland.

VIGNITE.

The Vignite of Karsten (Blau-Magneterz) is considered by Rammelsberg a simple mixture of magnetic iron ore and carbonate and phosphate of iron. Karsten obtained for its composition, Peroxyd of iron 49·03, protoxyd of iron 35·75, carbonic acid 11·19, phosphoric acid 4·03=100. It occurs in the Jura, near Vignes. (Kast. Archiv, xvi, 30.)

VIOLAN.

Breithaupt, Jour. f. pract. Chemie, xv, 321.

Amorphous. G.=3·233. Lustre waxy. Color violet-blue. Opaque. Fracture uneven to imperfectly conchoidal.

Violan is a silicate of alumina, magnesia, lime, much protoxyd of iron, and soda. With a high heat before the blowpipe, it fuses to a clear glass.

This mineral occurs with manganesian epidote, near St. Marcel in Piedmont.

VOLTAITE.

Primary form, the regular octahedron. Color brown or black.

Composition, according to Dufrénoy, Sulphuric acid 45·67, protoxyd of iron 28·69, alumina 3·27, potash 5·47, water 15·77=98·87. Dissolves in water with difficulty.

Voltaite is an iron-alum of quite peculiar composition. Abich has obtained a similar compound by art. It occurs at the Solfatara near Naples, where it was detected by Scacchi. (*V. Kobell*, J. f. pr. Chem. xxviii, 486.)

WEISSITE.

Wachtmeister, Kong. Vet. Acad. Handl., 1827, p. 80.

Reniform; sometimes foliated. Scratches glass, but is scratched by steel. G.=2·808. Lustre between pearly and waxy. Color ash-gray, slightly brownish. Scarcely translucent.

Composition, according to Wachtmeister, Silica, 53·69, alumina 21·70, magnesia 8·99, protoxyd of iron 1·43, protoxyd of manganese 0·63, potash 4·10, soda 0·68, oxyd of zinc 0·3, water with a little ammonia 3·20=100·72. Before the blowpipe it becomes pure white, and fuses on the edges. With borax it fuses slowly to a colorless glass.

This species occurs in Erik Matt's mine, Fahlun, thinly scattered in a chlorite slate, in reniform masses, about the size of a hazlenut.

A similar compound from Lower Canada has been analyzed by Tennant: it contained Silica 55·05, alumina 22·60, magnesia 5·70, protoxyd of iron 12·60, protoxyd of manganese *a trace*, lime 1·40, water 2·25=99·60. (Rec. of Gen. Sci. 1836, May, 332.)

WICHTINE.

Cleavage parallel to the sides of a rectangular prism. Scratches glass. Fracture flat conchoidal. Color black.

Composition, according to Laurent, Silica 56·3, alumina 13·3, protoxyd of iron 13·0, peroxyd of iron 4·0, soda 3·5, lime 6·0, magnesia 3·0=99·1.

Occurs at Wichty in Finland.

WOLCHONSKOITE.

Amorphous. Dull—shining. Color bluish-green, passing into grass-green. Streak bluish-green and shining. Feel resinous. Polished by the nail. Fracture subconchoidal. Adheres slightly to the tongue. Very fragile.

Composition, according to Berthier, (Mem. ii, 263,) and Kersten, (Pogg. xlvii, 489,)

Silica,	27·2	37·01
Oxyd of chromium,	34·0	17·93
Peroxyd of iron,	7·2	10·43
Alumina,	—	6·47
Magnesia,	7·2	1·91
Peroxyd of manganese,	—	1·66
Oxyd of lead,	—	1·01
Water,	23·2	21·84
Potash,	—=98·8, B.	trace=98·26, K.

Loses 32 per cent. of its weight when calcined, and becomes brown. Gelatinizes with hot concentrated muriatic acid, in which half the chromium is dissolved, the rest remains in union with the silica. From Siberia. Probably a mechanical mixture.

A *chrome ochre* afforded Drappier, Silica 64·0, alumina 23·0, oxyd of chrome 10·5, with some lime and magnesia.

The *Miloschine* or *Serbian* of Herder appears to be a chromiferous clay. Its color is blue or green. Streak the same. H.=2—2·5. G.=2·131.

Composition, according to Kersten, Alumina 45·01, silica 27·50, oxyd of chromium 3·61, lime 0·30, magnesia 0·20, water 23·30, potash and oxyd of iron *á trace*=99·92. (Pogg. xlvii, 485.) It occurs in Serbien, associated with quartz and brown iron ore.

YTTROCERITE.

Yttrocerite has been detected by Prof. Hitchcock among some minerals collected in Massachusetts; it is supposed to have come from the Bolton quarries. It has a purple color, and looks like a massive fluor spar.

ZEUXITE.

Thomson, Mineralogy, i, 320.

In small rectangular prismatic crystals, promiscuously arranged; loosely coherent. H.=4·25. G.=3·051. Lustre vitreous, glistening. Color brown, with a slight shade of green, when viewed in mass. Opaque.

Composition, according to Thomson, Silica 33·48, alumina 31·848, protoxyd of iron 26·01, lime 2·456, water 5·28=99·074. Before the blowpipe, in a glass tube, it gives out water, and emits an odor which may be called bituminous. Color deepened by the blowpipe, and the edges of the crystals rendered of a scoriaceous appearance. With borax it effervesces, and forms a dark brown glass.

It occurs in the Huel Unity Mine, three miles east of Redruth in Cornwall, and is hence named by Dr. Thomson, from *ζευξις*, *union*.

CATALOGUE

OF

AMERICAN LOCALITIES OF MINERALS.

The following catalogue has been made out to aid the mineralogical tourist in selecting his routes and arranging the plan of his journey. With this end in view, only important localities, affording cabinet specimens, have in general been given. The list is an abstract of the fuller information with regard to localities, scattered through the Descriptive part of this treatise.

The recent appearance of the various Reports by the several State Geologists, have enabled the author to give a completeness to this branch of American Mineralogy, before unattainable. For the facts included, the country is especially indebted to the Reports of Prof. Shepard of the Connecticut survey, Profs. Beck, Emmons, and Mather, Messrs. Vanuxem and Hall of the New York, Prof. Hitchcock of the Massachusetts, Dr. Jackson of the Maine, New Hampshire, and Rhode Island surveys, Prof. H. D. Rogers of the New Jersey, Prof. W. B. Rogers of the Virginia survey, and Prof. Troost and Houghton, and Mr. Owen, of the Western States: some distinguished names among the State Geologists are here omitted, as their regions were not mineral regions. The Journal of Science of Prof. Silliman, and the Transactions of the various scientific societies of the country, have also contributed essentially to this part of the work: and among the names in these Journals conspicuous in this department, in addition to the above enumerated, I would especially mention Messrs. A. Bruce, P. Cleaveland, B. Silliman, W. Meade, G. Gibbs, C. Dewey, J. F. Dana, F. Hall, T. Nuttall, H. H. Hayden, J. G. Percival, G. T. Bowen, D. Olmsted, H. Seybert, J. Porter, S. Fowler, T. G. Clemson, J. Delafield, J. Torrey, J. E. Teschemacher, C. B. Hayden, D. D. Owen of Indiana, G. Troost of Tennessee, O. P. Hubbard, B. Silliman, Jr., J. C. Booth, P. P. Tyson, J. Finch, J. B. Crawe, J. Johnston, G. W. Benedict, and J. Gebhard. The author would also acknowledge here his indebtedness for many private communications in this department, especially from Messrs. B. Silliman, Jr. of New Haven, Joseph A. Clay of Philadelphia, F. Markoe of Washington, and James Heron of Warwick, N. Y.

In making out the catalogue, the names of those minerals which are obtained in good specimens at the several localities, are distinguished by italics. When the specimens are remarkably good, an exclamation mark (!) has been added, or two of these marks (!!) when the specimens are quite unique. If a locality that has afforded peculiarly fine specimens is now exhausted, the exclamation mark has been inverted (¡). The more exact position of localities may in most instances be ascertained by reference to the description of the species in the preceding part of the treatise.

MAINE.

Mt. Abraham.—*Andalusite*, staurotide.
Albany.—*Beryl! green and black tourmalines, feldspar, rose quartz.*
Albion.—Iron pyrites.
Aroostook.—Red hematite.
Bingham.—*Massive pyrites*, galena, blende, andalusite.
Blue Hill Bay.—*Arsenical iron, molybdenite! galena, apatite! fluor spar!* black tourmaline, (Long Cove,) black oxyd of manganese, (Osgood's farm,) red manganese, bog manganese, wolfram.
Bowdoinham.—*Beryl*, molybdenite.
Brunswick.—*Green mica, garnet! black tourmaline!* molybdenite.
Buckfield.—*Garnet*, (estates of Waterman and Lowe,) iron ore
Camdage Farm.—(Near the tide mills,) molybdenite, (wolfram.)
Camden.—*Macle.*
Carmel, (Penobscot Co.)—*Gray antimony.*
Corinna.—*Iron pyrites, arsenical pyrites.*
Deer Isle.—*Serpentine, verd antique*, asbestus, diallage.
Dexter.—Galena, pyrites, blende, copper pyrites, green talc.
Dixfield.—Native copperas, graphite.
Farmington.—(Norton's ledge,) *pyrites*, graphite, bog ore.
Georgetown.—(Parker's island,) *beryl!* black tourmaline.
Greenwood.—Graphite, black manganese.
Hartwell.—Staurotide.
Lenox.—Galena, pyromorphite.
Lewiston.—Garnet.
Lubec Lead Mines.—*Galena, copper pyrites, blende*, pyromorphite, an ore of bismuth.
Newfield, (Bond's Mt.)—Mispickel, olive phosphate of iron in botryoidal masses.
Paris.—*Green!! red!! black*, and *blue tourmaline! mica! lepidolite!* feldspar, *albite, quartz crystals! rose quartz*, *blende.*
Parsonsfield.—*Idocrase! yellow garnet, pargasite, adularia, scapolite*, galena, blende, copper pyrites.
Perry.—Prehnite and calc spar, (above Loring's cove,) quartz crystal, calc spar, analcime, apophyllite, agate, (Gin cove.)
Peru.—*Crystallized pyrites.*
Phipsburg.—*Yellow garnet! manganesian garnet, idocrase, pargasite, axinite, laumonite!* chabazite, an ore of cerium?
Poland.—Idocrase.
Raymond.—*Magnetic iron, scapolite, pyroxene, lepidolite, tremolite*, hornblende.
Rumford.—*Yellow garnet, idocrase, pyroxene*, apatite, scapolite, graphite.
Searsmont.—*Andalusite.*
Streaked Mountain.—*Beryl! black tourmaline, mica, garnet.*
Thomaston.—*Calc spar, tremolite, hornblende*, sphene, arsenical iron, (Owl's head,) black manganese, (Dodge's mountain.)
Warren.—Galena, blende.
Waterville.—*Crystallized pyrites.*
Windham, (near the bridge.)—*Staurotide! spodumene, garnet.*
Woodstock, (New Brunswick.)—*Graphite, specular iron.*

NEW HAMPSHIRE.

Acworth.—*Beryl! mica, tourmaline, feldspar, albite, rose quartz, columbite.*
Alstead.—*Mica! albite, black tourmaline.*
Amherst.—*Idocrase! yellow garnet*, pargasite, calc spar.
Bartlett.—Magnetic iron, brown iron ore in large veins near Jackson (on "Bald face mountain.")
Bath.—Galena.
Bellows Falls.—*Fibrolite*, (var. of kyanite,) wavellite, near Saxton's river.
Canaan.—Gold in pyrites.
Charlestown.—*Staurotide macle! andalusite-macle*, bog iron ore.
Cornish.—Gray antimony, antimonial argentiferous gray copper, *rutile in quartz!!*

Eaton, (3 m. S. of.)—*Galena, blende*, copper pyrites, limonite, (six mile pond.)
Francestown.—*Soapstone*, arsenical pyrites.
Franconia.—(*Hornblende, staurotide! epidote! zoisite, specular iron, magnetic iron, black* and *red manganesian garnets! mispickel!*) (Danaite,) copper pyrites, molybdenite.
Gilford, (Gunstock Mt.)—Magnetic iron ore, (native "loadstone.")
Goshen.—*Graphite*, black tourmaline.
Grafton.—*Mica*, (extensively quarried,) *albite!* asparagus stone, blue, green, and yellow *beryls*.
Hanover.—*Garnet*, a boulder of quartz containing *rutile!!*
Haverhill.—*Garnet! arsenical pyrites, native arsenic*, galena, blende, iron and copper pyrites, magnetic and white iron pyrites.
Hillsboro, (Campbell's mountain.)—*Graphite.*
Hinsdale.—Manganese spar, black oxyd of manganese, (photozite and rhodontite.)
Jackson.—Drusy quartz, *tin ore, arsenical pyrites*, native arsenic, fluor spar, apatite, *magnetic iron ore, molybdenite*, wolfram, copper pyrites, arseniate of iron.
Jaffrey, (Monadnock Mt.)—*Kyanite*, (var. fibrolite.)
Keene.—*Graphite, soapstone*, milky quartz.
Landaff.—*Molybdenite*, lead and iron ores.
Lisbon.—*Staurotide, garnets* black and red, *granular magnetic iron ore, hornblende, epidote, zoisite, specular iron.*
Lyme.—Kyanite, (N. W. part,) *black tourmaline*, rutile, iron pyrites, copper pyrites, (E. of E. village,) *sulphuret of antimony.*
Merrimack.—*Rutile!* (in gneiss nodules in granite vein.)
Moultonborough, (Red Hill.)—*Hornblende*, bog ore, pyrites, tourmaline.
Orange.—*Blue beryls!*
Orford.—*Brown tourmaline! steatite, rutile*, kyanite, brown iron ore, native copper, green malachite, galena.
Piermont.—*Micaceous iron, heavy spar*, green, white, and brown mica, apatite.
Richmond.—*Iolite!* rutile, soapstone, iron pyrites.
Saddleback Mt.—Black tourmaline, garnet, spinel.
Shelburn.—*Argentiferous galena, crystalline black cupreous blende! copper and iron pyrites*, manganese.
Springfield.—Beryls, (very large, 8 inches diameter,) *manganesian garnets!* in mica slate, *albite, mica.*
Swanzey, (near Keene.)—*Magnetic iron* (in masses in granite.)
Tamworth, (near White Pond.)—Galena.
Unity, (estate of James Neal.)—*Copper and iron pyrites, chlorophyllite, green mica, magnetic iron, radiated actinolite*, garnet, *titaniferous iron ore, magnetic iron ore.*
Walpole, (near Bellows Falls.)—*Macle.*
Warren.—*Copper pyrites, blende, epidote*, quartz, *iron pyrites, tremolite! galena, rutile, talc*, molybdenite.
Westmoreland, (South part.)—*Molybdenite! apatite! blue feldspar, bog manganese*, (North village,) quartz, *fluor spar*, copper pyrites, oxyd of molybdena and uranium.
White Mts. (Notch, behind "old Crawford's house.")—Green octahedral *fluor*, quartz crystals, black tourmaline.
Wilmot.—*Beryl.*
Winchester.—Pyrolusite, photozite, diallogite, black oxyd of manganese, magnetic iron ore, granular quartz.

VERMONT.

Bellows Falls.—Kyanite, (var. fibrolite.)
Bennington.—*Pyrolusite*, brown iron ore.
Bridgewater.—*Talc, dolomite, magnetic iron.*
Chittenden.—Psilomelane, pyrolusite.
Grafton.—*Steatite.*
Marlboro.—*Rhomb spar, steatite, garnet, magnetic iron.*
Middlebury.—Zircon.
Monkton.—*Pyrolusite*, brown iron ore.
Mount Holly.—*Asbestus.*
New Fane.—*Glassy* and *asbestiform actinolite, steatite, green quartz*, (called chrysoprase at the locality,) chalcedony, drusy quartz, *garnet, chromic iron, rhomb spar.*
Pittsford.—*Brown iron ore.*

Plymouth.—Spathic iron.
Plympton.—Massive hornblende.
Putney.—Fluor, *brown iron ore.*
Readsboro.—*Glassy actinolite, steatite.*
Ripton.—*Brown iron ore.*
Roxbury.—*Dolomite, talc.*
Shoreham.—*Iron pyrites.*
Shrewsbury.—Magnetic iron, and copper pyrites.
Somerset.—Magnetic iron, native gold.
Stafford.—Magnetic iron, and copper pyrites.
Troy.—*Crystalline magnetic iron*, talc.
Waterville.—*Steatite.*
Willardsboro.—*Zoisite.*
Windham.—*Glassy actinolite, steatite.*

MASSACHUSETTS.

Alford.—Galena, iron pyrites.
Athol.—*Allanite*, fibrolite, (?) *epidote!*
Auburn.—*Masonite.*
Barre.—*Rutile! mica, pyrites, beryl, feldspar, garnet.*
Great Barrington—*Tremolite.*
Bedford—*Garnet.*
Belchertown.—Allanite.
Bernardston.—Magnetic oxyd of iron.
Beverly.—Polymignite, Columbite, *green feldspar*, tin ore.
Blanford.—*Marmolite, Schiller spar, serpentine, anthophyllite, actinolite! chromic iron*, kyanite, rose quartz in boulders.
Bolton.—*Scapolite!, petalite, sphene, pyroxene, Nuttallite, diopside, Boltonite*, apatite, magnesite, rhomb spar, *Allanite, Yttrocerite*, cerium ochre, (on the scapolite,) spinel.
Boxborough.—*Scapolite*, spinel, *garnet*, augite, actynolite, apatite.
Brighton.—Asbestus.
Brimfield, (road leading to Warren.)—*Iolite*, adularia, molybdenite, mica, garnet.
Carlisle.—*Tourmaline, garnet! scapolite*, actynolite.
Charleston.—*Prehnite, Laumonite*, stilbite, chabazite, quartz crystals.
Chelmsford.—*Scapolite, chondrodite, blue spinel; amianthus!* rose quartz.
Chester.—*Hornblende, scapolite, zoisite, spodumene, indicolite*, apatite—magnetic iron and *chromic iron*, (west part)—Stilbite, Heulandite, analcime and chabazite.
Chesterfield.—*Blue, green, and red tourmaline, Cleavelandite*, (albite,) *lithia mica, smoky quartz, pyrochlore* (microlite,) *spodumene, kyanite*, apatite, *rose beryl, garnet, quartz crystals, staurotide*, tin ore, *Columbite;* variegated copper ore, zoisite, uranite.
Conway.—Pyrolusite, fluor spar, zoisite, *rutile!!* native alum, galena.
Cummington.—*Manganese spar! Cummingtonite*, white iron pyrites, *garnet.*
Dedham.—Asbestus, galena.
Deerfield.—Chabazite, Heulandite, stilbite, amethyst, carnelian, chalcedony, *agates!*
Fitchburg, (Pearl Hill.)—*Beryl, staurotide!* garnets, molybdenite.
Foxborough.—*Iron pyrites, anthracite.*
Franklin.—Amethyst.
Goshen.—*Lithia mica, albite, spodumene! blue and green tourmaline, beryl, zoisite*, smoky quartz, Columbite, tin ore, smoky quartz, galena, phenakite.(?)
Hatfield.—*Heavy spar*, yellow quartz crystals, galena, blende, yellow copper pyrites.
Hawley.—*Micaceous iron*, massive pyrites, magnetic iron, zoisite.
Heath.—*Pyrites, zoisite.*
Hinsdale.—Brown iron ore, apatite, zoisite.
Hubbardston.—*Massive pyrites.*
Lancaster.—*Kyanite*, (var. fibrolite,) *chiastolite!* apatite, staurotide, pinite, andalusite.
Lee.—*Tremolite! sphene*. (east part.)
Lenox.—Brown hematite, Gibbsite. (?)
Leverett.—Heavy spar, galena, blende, copper pyrites.
Leyden.—*Zoisite, rutile.*
Littleton.—Spinel, scapolite, apatite.
Lynnfield.—Magnesite on serpentine.
Martha's Vineyard.—Brown iron ore, *amber*, selenite, radiated pyrites.

Mendon.—*Mica!* chlorite.
Middlefield.—*Glassy actinolite, rhomb spar, steatite, serpentine, feldspar,* drusy quartz, apatite, zoisite, nacrite, chalcedony, *talc!*
Montague.—Specular iron.
Newbury.—*Serpentine,* amianthus, *epidote, massive garnet,* carbonate of iron.
Newburyport.—*Serpentine, nemalite,* uranite.
New Braintree.—*Black tourmaline.*
Norwich.—*Apatite! black tourmaline, beryl,* blende, quartz crystals.
Palmer, (Three Rivers.)—*Feldspar,* Prehnite, calc spar.
Pelham.—*Asbestus,* serpentine, *quartz crystals,* beryl, *molybdenite, green hornstone;*
Plainfield.—*Cummingtonite, pyrolusite, red manganese.*
Richmond.—*Brown iron ore, Gibbsite* (cryst.)*!!*
Rowe.—Epidote, talc.
Russel.—Schiller spar, (diallage?) *prismatic mica,* serpentine, beryl, galena, copper pyrites.
Saugus.—*Jasper.*
Sheffield.—*Asbestus,* pyrites, native alum, pyrolusite.
Shelburne.—Rutile.
Shutesbury, (east of Locke's Pond.)—*Molybdenite.*
Southampton.—*Galena;* white lead ore, anglesite, molybdate of lead, fluor, heavy spar, copper and iron pyrites, blende, corneous lead; pyromorphite.
South Royalston.—*Beryl!! common mica!! feldspar! Ilmenite, Allanite.*
Sterling.—*Spodumene, chiastolite, spathic iron, mispickel, blende,* galena, iron and copper pyrites.
Stoneham.—*Nephrite.*
Sturbridge.—*Graphite,* pyrope, apatite, bog ore.
Turner's Falls, (Conn. R.)—Copper pyrites, Prehnite, chlorite, *chlorophæite!* spathic iron, green malachite, magnetic iron sand, anthracite.
Tyringham.—Pyroxene, scapolite.
Uxbridge.—Argentiferous galena.
Warwick.—*Massive garnet, black tourmaline, magnetic iron,* beryl, epidote.
Washington.—*Graphite.*
Westfield.—*Schiller spar,* (diallage?) *serpentine, steatite,* kyanite, (var. fibrolite,) scapolite, actinolite.
Westford.—*Andalusite!*
West Hampton.—*Galena, argentine! pseudomorphous quartz!*
West Springfield.—*Prehnite,* ankerite, satin spar, celestine, bituminous coal.
West Stockbridge.—*Hematite,* fibrous pyrolusite, spathic iron.
Whately.—*Native copper,* galena.
Williamsburg.—Zoisite, pseudomorphous quartz, apatite, rose and smoky quartz, galena, pyrolusite, copper pyrites.
Williamstown.—*Cryst. quartz.*
Windsor.—*Zoisite,* actinolite, *rutile!*
Worcester.—*Mispickel,* idocrase, pyroxene, garnet, amianthus, Bucholzite, spathic iron, galena, *anthracite.*
Worthington.—*Kyanite.*
Zoar.—Bitter spar, *talc.*

RHODE ISLAND.

Bristol.—*Amethyst;*
Cranston.—Actinolite in talc.
Cumberland.—*Manganese spar, epidote, actinolite,* garnet, titaniferous iron, magnetic iron, red hematite, copper pyrites.
Foster.—*Kyanite!*
Johnson.—Talc, brown spar.
Newport.—*Serpentine.*
Portsmouth.—*Anthracite,* graphite, asbestus, iron pyrites.
Smithfield.—*Dolomite, calc spar, bitter spar, nacrite, nephrite,* tremolite, asbestus, quartz, magnetic iron in chlorite slate, *talc!!*
Warwick, (Natic village.)—*Masonite!* (of Jackson,) garnets, graphite.
Westerly.—*Ilmenite* (Shepard's Washingtonite.)

CONNECTICUT.

Berlin.—Heavy spar, datholite, blende, quartz crystals.
Bolton.—Staurotide, copper pyrites.
Bradleyville (Litchfield).—Laumonite.
Bristol.—*Vitreous copper*, copper pyrites, heavy spar, variegated copper ore, talc.
Brookfield.—Galena, calamine, *blende*, spodumene, magnetic pyrites.
Canaan.—*Tremolite*, and *augite!* in dolomite.
Chatham.—Mispickel, smaltine, copper nickel, *beryl*.
Cheshire.—*Heavy spar! vitreous copper, cryst. variegated copper! green malachite*, kaolin, natrolite, Prehnite, chabazite, datholite.
Chester.—*Sillimanite!* monazite, epidote.
Cornwall, near the Housatonic.—*Graphite, pyroxene*.
Farmington.—*Prehnite! chabazite*, heavy spar, agate, native copper.
Granby.—Green malachite.
Greenwich.—*Black tourmaline*.
Haddam.—*Chrysoberyl! beryl! epidote!! tourmaline!! feldspar, anthophyllite, garnet! iolite! chlorophyllite! automolite! magnetic iron, adularia*, apatite, *Columbite!* white and yellow iron pyrites, *molybdenite! Allanite*, sulphuret of Bismuth.
Hadlyme.—Chabazite and stilbite in gneiss, with epidote and garnet.
Hartford.—*Datholite* (Rocky Hill quarry).
Kent.—*Brown iron ore*, pyrolusite, ochrey iron ore.
Litchfield.—*Kyanite*, with corundum, apatite and andalusite, *Ilmenite*, (Washingtonite).
Lyme.—Garnet, sunstone.
Meriden.—Datholite.
Middlefield Falls.—Datholite, chlorite, &c. in amygdaloid.
Middletown.—*Mica, lepidolite* with green and red tourmaline, *albite, feldspar, Columbite! Prehnite, rutile*, beryl, topaz, uranite, apatite.
Milford.—Sahlite, *pyroxene, asbestus*, zoisite, verd-antique marble, pyrites.
New Haven.—Serpentine, asbestus, chromic iron, sahlite, stilbite, Prehnite.
Norwich.—*Sillimanite, monazite!* (Edwardsite of Shepard,) zircon, *iolite*, corundum, feldspar.
Orange.—Pyrites.
Oxford, near Humphreysville.—Kyanite.
Roaring Brook (Cheshire).—*Datholite!* calc spar, Prehnite, saponite.
Reading (near the line of Danbury).—Pyroxene, *garnet*.
Roxbury.—Massive *spathic iron*, blende.
Salisbury.—*Brown iron ore*, ochrey iron, *pyrolusite!*
Saybrook.—*Molybdenite*, stilbite.
Simsbury.—*Vitreous copper*, green malachite.
Southbury.—Rose quartz, laumonite, prehnite.
Southington.—Heavy spar, datholite.
Stafford.—Massive pyrites.
Stonington.—Stilbite and *chabazite* on gneiss.
Thatchersville, (near Bridgeport).—Stilbite on gneiss, Babingtonite.
Tolland.—Staurotide, massive pyrites.
Trumbull and Monroe.—*Chlorophane, Topaz, beryl*, euclase (?) magnetic pyrites, iron pyrites, *tungstate of lime, wolfram* (pseudomorph of tungsten,) rutile, native bismuth, tungstic acid, spathic iron, topaz, mispickel, argentiferous galena, blende, scapolite, *tourmaline, garnet*, albite, augite, graphic tellurium (?).
Washington.—*Triphyline, Ilmenite!* (Washingtonite of Shepard,) diallogite, natrolite, *andalusite* (New Preston,) kyanite.
Watertown, near the Naugatuck.—White Sahlite, monazite.
West Farms.—Asbestus.
Winchester and Wilton.—Asbestus.

NEW YORK.

ALBANY CO.

Coeyman's Landing.—Epsom salt.
Guilderland.—*Petroleum*.

ALLEGANY CO.

Cuba.—*Petroleum*.

Cattaraugus Co.

Freedom.—*Petroleum.*

Cayuga Co.

Auburn.—Fluor, epsom salt.
Ludlowville.—Epsom salt.

Columbia Co.

Ancram Lead Mine.—Galena, *blende, copper pyrites,* heavy spar.
Austerlitz.—*Earthy manganese,* molybdate of lead, vitreous copper.

Dutchess Co.

Dover.—*Garnet* (Foss ore-bed.)
Fishkill.—*Graphite, green actinolite! talc,* hydrous anthophyllite.
Rhinebeck.—Granular epidote.
Union Vale.—*Gibbsite* (Clove mine.)
Amenia.—Stalactitic hematite.

Alexandria.—Kirby's graphite mine, *graphite, pyroxene, scapolite,* sphene.
Crown Point.—*Garnet, massive feldspar, epidote,* epsom salt, apatite (cupyrchroite of *Emmons,*) magnetic iron (Peru.)
Keene.—*Scapolite, coccolite.*
Lewis.—*Tabular spar, colophonite,* garnet, *Labradorite.*
Long Pond.—*Apatite, garnet, pyroxene,* idocrase.
Moriah.—*Zircon! calc spar,* apatite, actinolite (Sanford ore-bed,) Labradorite, mica, specular iron.
Port Henry.—*Brown tourmaline, mica, rose quartz, serpentine, green* and *black pyroxene,* hornblende, *cryst. pyrites, magnetic pyrites.*
Rogers's Rock.—*Graphite, tabular spar, garnet, colophonite, feldspar,* adularia, *pyroxene, sphene,* coccolite.
Schroon.—*Calc spar,* pyroxene.
Ticonderoga.—*Graphite, pyroxene, sahlite, sphene,* black tourmaline, cacoxenite (Mt. Defiance.)
Westport.—Labradorite, Prehnite.
Willsboro.—*Tabular spar, colophonite,* garnet, *green coccolite,* hornblende.

Franklin Co.

Malone.—*Massive pyrites.*

Greene Co.

Catskill.—*Calc spar.*
Diamond Hill.—Quartz crystals.

Herkimer Co.

Fairfield.—*Quartz crystals!*
Little Falls.—*Quartz crystals, heavy spar, calc spar,* anthracite.
Middlefield.—*Quartz crystals! calc spar,* brown and pearl spar.
Salisbury.—*Quartz crystals!* blende, galena, iron and copper pyrites.
Stark.—*Fibrous celestine.*

Jefferson Co.

Antwerp.—*Quartz crystals! serpentine! calc spar, spinel,* mica, *spathic iron, specular iron,* arragonite, *cacoxene!* terenite, tremolite, *fluor,* green malachite.
Brownville.—Celestine.
Carthage.—Cacoxene.
Champion.—Pyrites.
Chaumont Bay.—Celestine.
Depauville.—Celestine.
Henderson.—*Mica!*
High Island, (in the St. Lawrence.)—*Tourmaline.*

Muscolonge Lake.—*Fluor!! mica*, strontianite, idocrase.
Oxbow.—*Calc spar!!* heavy spar.
Vrooman Lake, near Oxbow.—*Apatite! quartz crystals, calc spar*, pyroxene, *mica!* tourmaline, pyrites.
Pillar Point.—*Massive heavy spar.*
Watertown.—*Tremolite.*

LEWIS CO.

Diana, (natural bridge.)—*Scapolite! tabular spar, green coccolite, feldspar*, apatite, *sphene*, mica, *quartz crystals*, drusy quartz, *cryst. pyrites*, magnetic pyrites, blue calc spar, serpentine, *Rensselaerite.*
Houseville.—*Earthy manganese.*
Leyden.—*Calc spar.*
Lowville.—*Calc spar*, fluor, pyrites.
Martinsburgh.—*Calc spar*, fluor, *cryst. pyrites*, galena, blende.

MONROE CO.

Rochester.—*Pearl spar*, calc spar, snowy gypsum, fluor, celestine, galena, blende.

MONTGOMERY CO.

Root.—Pearl spar, *drusy quartz, blende.*
Palatine.—*Quartz crystals*, drusy quartz.

NEW YORK CO.

Corlaer's Hook.—Apatite.
Kingsbridge.—*Tremolite, pyroxene, mica, tourmaline*, pyrites, rutile.
Haarlem.—Epidote, apophyllite, stilbite, tourmaline, vivianite, lamellar feldspar, mica.
New York.—*Serpentine, amianthus*, actinolite, talc, *pyroxene*, hydrous anthophyllite, garnet, staurotide, molybdenite, graphite.

NIAGARA CO.

Lockport.—*Celestine! calc spar, selenite, anhydrite, fluor, pearl spar! blende.*
Niagara Falls.—*Calc spar*, fluor, blende.

ONEIDA CO.

Boonville.—*Calc spar, tabular spar*, coccolite.
Clinton.—Blende, *lenticular argillaceous iron ore.*

ONONDAGA CO.

Camillus.—*Selenite* and *fibrous gypsum.*
Manlius.—*Gypsum* and fluor.
Syracuse.—*Serpentine.*

ORANGE CO.

Cornwall.—*Zircon, chondrodite, hornblende, spinel, massive feldspar, fibrous epidote*, Hudsonite, Ilmenite, *serpentine*, Boltonite.
Deer Park.—*Cryst. pyrites*, galena.
Monroe.—*Mica! sphene! garnet*, colophonite, *epidote, chondrodite*, Allanite, Bucholzite, brown spar, Boltonite, *spinel*, hornblende, talc, *Ilmenite, magnetic pyrites*, common pyrites, chromic iron, *graphite.*
At Two Ponds in Monroe.—*Pyroxene! chondrodite, hornblende, scapolite! zircon, sphene*, apatite, Boltonite.
At Greenwood Furnace.—*Chondrodite, pyroxene! mica! hornblende, spinel, scapolite, mica*, Ilmenite.
At Forest of Dean.—*Pyroxene, spinel*, zircon, scapolite, hornblende, Boltonite.
Town of Warwick.—
Warwick Village.—*Spinel, zircon, serpentine! brown spar, pyroxene! hornblende!! pseudomorphous steatite; feldspar!* (Rock Hill,) *Ilmenite, Clintonite*, tourmaline (R. H.,) *rutile*, sphene, molybdenite, mispickel, *white iron pyrites*, common pyrites, yellow iron sinter.
Amity.—*Spinel, garnet, scapolite, hornblende, idocrase, epidote! Clintonite! magnetic iron! tourmaline, Warwickite, apatite, chondrodite*, Ilmenite, *talc, pyroxene!* rutile, *zircon, corundum, feldspar*, sphene, calc spar, serpentine, schiller spar. (?)

Edenville.—*Apatite, chondrodite! hair brown hornblende!* tremolite, *spinel, tourmaline, Warwickite, pyroxene, sphene, mica, feldspar, mispickel, rutile, Ilmenite,* scorodite, copper pyrites.

West Point.—*Feldspar, mica,* scapolite.

PUTNAM CO.

Carmel, (Brown's quarry.)—Anthophyllite, schiller spar, (?) orpiment, mispickel.

Cold Spring.—Chabazite, mica, sphene.

Patterson.—*White pyroxene! calc spar, asbestus, tremolite,* dolomite, massive pyrites.

Phillipstown.—*Tremolite, amianthus, serpentine, sphene, diopside, green coccolite,* hornblende, *scapolite,* stilbite, mica, Laumonite, Gurhofite, calc spar, magnetic iron, chromic iron.

Phillip's ore bed.—Hyalite, *actinolite, massive pyrites.*

RENSSELAER CO.

Lansingburgh.—Epsom salt, quartz crystals.

RICHMOND CO.

Rossville.—Lignite, *cryst. pyrites.*

Quarantine.—*Asbestus! amianthus, magnesite, dolomite, Gurhofite,* Brucite, serpentine, *talc.*

ROCKLAND CO.

Caldwell.—*Calc spar!*

Grassy Point.—Serpentine, actinolite.

Haverstraw.—*Hornblende.*

Ladentown.—Zircon, red copper ore, green malachite.

Piermont.—Datholite, stilbite, apophyllite, stellite, Prehnite, Thomsonite, mcmalite, calc spar.

Stony Point.—Kerolite, lamellar hornblende, asbestus.

ST. LAWRENCE CO.

Canton.—*Massive pyrites.*

Dekalb.—*Hornblende!* heavy spar, *fluor,* tremolite, *tourmaline.*

De Long's Mills, in Hammond.—*Feldspar! pyroxene, satin spar,* zircon, apatite.

Edwards.—*Brown and silvery mica!* scapolite, apatite, *quartz crystals,* actinolite, tremolite, specular iron.

Fowler.—*Heavy spar, quartz crystals! specular iron, blende,* galena, iron and copper pyrites, actinolite.

Gouverneur.—*Calc spar! serpentine! hornblende! scapolite! feldspar!! tourmaline!* pyroxene, apatite, *Rensselaerite, sphene, heavy spar,* rutile, *pseudomorphous steatite,* black and copper colored *mica,* tremolite, asbestus.

Hammond.—*Apatite!! zircon!! feldspar,* heavy spar, pyrites.

Hermon.—*Quartz crystals, specular iron, spathic iron.*

Mineral Point, Morristown.—Fluor, blende, galena, mica, (Pope's Mills, Morristown.)

Potsdam.—*Hornblende!*—eight miles from Potsdam on road to Piermont; *feldspar! tourmaline, black mica.*

Rossie, (Parish ore bed.)—Heavy spar, *specular iron,* coralloidal arragonite.

Rossie Lead Mine.—*Calc spar!! galena!! pyrites! celestine,* copper pyrites, white lead ore, anglesite.

Rossie, (Laidlaw Lake.)—*Calc spar, heavy spar,* quartz crystals, chondrodite, *pargasite,* pyroxene, sphene. Elsewhere in Rossie.—*Feldspar! pargasite! apatite, pyroxene, mica, apatite,* fluor, serpentine, automolite.

Somerville.—Chondrodite, light blue spinel.

SARATOGA CO.

Greenfield.—*Chrysoberyl! garnet, tourmaline! mica, feldspar,* apatite, graphite.

SCOHARIE CO.

Ball's Cave, and others.—Calc spar, stalactites.

Carlisle.—*Fibrous sulphate of baryta, cryst. and fib. carbonate of lime.*

Scoharie.—Fibrous celestine, *strontianite! cryst. pyrites!*

Sullivan Co.

Wurtzboro'—*Galena, blende, pyrites, copper pyrites.*

Ulster Co.

Ellenville—Galena, blende, copper pyrites, quartz.
Marbletown—Pyrites.

Warren Co.

Caldwell—*Massive feldspar.*
Chester—*Pyrites*, tourmaline, rutile, copper pyrites.
Diamond Isle, (Lake George)—*Calc spar, quartz crystals.*
Glenn's Falls—Rhomb spar.
Johnsburg—*Fluor! zircon!! graphite, serpentine, pyrites.*

Washington Co.

Fort Ann—*Graphite.*
Granville—*Lamellar pyroxene*, massive feldspar, epidote.
Putnam—*Lamellar pyroxene*, massive feldspar, epidote.

Wayne Co.

Wolcott—*Heavy spar.*

Westchester Co.

Anthony's Nose—*Apatite*, pyrites.
Davenport's Neck—*Serpentine*, garnet, sphene.
Eastchester—Blende, copper and iron pyrites, dolomite.
Hastings—*Tremolite, white pyroxene.*
New Rochelle—*Serpentine*, Brucite, magnesite, quartz, *mica*, tremolite, garnet.
Peekskill—Mica, feldspar, hornblende, stilbite.
Rye—*Serpentine, chlorite, black tourmaline*, tremolite, kerolite.
Singsing—*Pyroxene, tremolite, iron pyrites*, copper pyrites, beryl, azurite, green malachite, white lead ore, pyromorphite, Anglesite, Vauquelinite, galena, native silver.
West Farms—Apatite, tremolite, garnet, stilbite, Heulandite, chabazite, epidote, sphene.
Yonkers—*Tremolite*, apatite, calc spar, malacolite, *pyrites*, tourmaline.
Yorktown—*Sillimanite, monazite*, magnetic iron.

NEW JERSEY

Allentown, (Monmouth Co.)—Vivianite.
Belville—Copper mines.
Bergen—*Calc spar, datholite, Thomsonite, pectolite* (called stellite,) *analcime, epistilbite, apophyllite, Prehnite*, sphene, stilbite, natrolite, Heulandite, Laumonite, chabazite, pyrites, pseudomorphous steatite imitative of apophyllite.
Brunswick—Copper mines, *native copper, malachite, mountain leather.*
Danville (Jenny Jump ridge)—*Graphite*, chondrodite, augite, mica.
Flemington—*Copper mines.*
Frankfort—*Serpentine.*
Franklin and Hamburgh, near the Franklin Furnace—*Spinel!! garnet! manganese spar (Fowlerite)!! Troostite!! Franklinite!! red zinc ore! dysluite!! hornblende, tremolite, chondrodite, white scapolite, black tourmaline, epidote, pink calc spar, mica*, actinolite, augite, sahlite, coccolite, asbestus, *Jeffersonite*, calamine, graphite, fluor, beryl, galena, serpentine, honey colored sphene, quartz, chalcedony, amethyst, zircon, molybdenite, vivianite.
Franklin and Warwick Mts.—*Pyrites!*
Greenbrook—Copper mines.
Griggstown—Copper mines.
Imlaytown—Vivianite.
Lockwood—*Graphite, chondrodite, talc, augite, quartz, green spinel.*
Mullica Hill, (Gloucester Co.)—*Vivianite*, lining belemnites.

Newton.—*Spinel, blue and white corundum, mica, idocrase, hornblende, tourmaline, scapolite,* rutile, pyrites, talc, calc spar, heavy spar, *pseudomorphous steatite.*
Patterson.—*Datholite.*
Schuyler's Mines.—Green malachite, red copper ore, native copper, *chrysocolla.*
Somerville.—*Red copper ore, native copper, chrysocolla,* green malachite, bitumen (two miles to the northeast.)
Sparta.—*Chondrodite! spinel,* sapphire, green talc, graphite, epidote, augite.
Suckasunny, on the Morris Canal.—*Brown apatite* in magnetic pyrites.
Trenton.—Zircon, amber, lignite.
Vernon.—*Green spinel, chondrodite.*

Note.—From Amity, N. Y., to Andover, N. J., a distance of about thirty miles, the outcropping limestone, at different points, affords more or less of the minerals enumerated as occurring at Franklin. (See Geol. Rep. on N. J., by H. D. Rogers.)

PENNSYLVANIA.

Berks Co.

Morgantown.—*Malachite! chrysocolla! oct. and dodec. magnetic iron, copper pyrites.*

Bucks Co.

Three miles west of Attleboro.—*Pyroxene, scapolite,* feldspar, tabular spar, (a boulder, now exhausted,) zircon, apatite, sphene, green coccolite, *graphite.*—Opposite New Hope in N. J., *black tourmaline.*

Cambria Co.

Strasberg.—Epsom salt.

Chester Co.

Coralloidal arragonite. At London Grove: *tremolite,* apatite. At Newlin: *corundum, beryl.* At Phenixville: *pearl spar!* calc spar, quartz crystals, *Brookite;* on quartz. Near Westchester: zircon, *cryst. magnesite,* amethyst, mang. garnet, oxyd of manganese. South part of Chester Co.: epidote, *magnetic iron ore, rutile.*

Delaware Co.

Corundum, andalusite, aventurine feldspar, amethyst, green quartz. At Leiperville: *beryl! black tourmaline!* apatite, garnet. At Concord, Greene's creek: *garnet* (pyrope?)! *Bucholzite.*

Huntington Co.

Frankstown, Logan's valley, and near Alexandria: *fibrous celestine!*

Lancaster Co.

Anthophyllite. At Little Britain: *cryst. pyrites, moss agate,* chalcedony. At Sadsbury: *rutile!!*

Montgomery Co.

At Perkiomen lead mine: *blue malachite, green malachite, blende, galena, pyromorphite, white lead ore;* molybdate of lead, cupreous sulphate of lead?, anglesite; *heavy spar,* calamine;

Northumberland Co.

Opposite Selim's grove.—Electric calamine.

Northampton Co.

Easton.—*Zircon!!* (rare,) *nephrite, saussurite?, tremolite, serpentine* (pseudomorphic of calc spar—rare,) pyroxene, coccolite, pink carbonate of lime, argillaceous iron ore.

Philadelphia Co.

Near Columbia railroad bridge, on the Schuylkill.—*Laumonite!* (inaccessible.) On the Schuylkill road, near Darnley bridge: *kyanite.* At Chesnut Hill: *mica, serpentine, dolomite, asbestus,* tremolite, nephrite, talc, tourmaline, sphene. Near the Wissahiceon creek: *staurotide,* actinolite. Near Germantown: *mica, apatite,* (coarse,) beryl; feldspar.
Near Nicholson's Gap, Blue Ridge: blue malachite.

DELAWARE.

Dixon's quarry, seven miles from Wilmington.—*Cinnamon stone!!* (exhausted,) *blue apatite, glassy feldspar*, sahlite, sphene in pyroxene, kyanite.
Brandywine Springs.—*Bucholzite*, sahlite.
Chesapeake and Delaware Canal.—*Retinasphalt.*
Newcastle Co.—Vivianite;

MARYLAND.

Baltimore, (Jones Falls, 1½ miles from B.)—*Haydenite*, Heulandite (Beaumontite of Levy,) pyrites, lenticular carbonate of iron, *mica, stilbite.*
Sixteen miles from Baltimore, on the Gunpowder.—*Graphite.*
Twenty-three miles from B. on the Gunpowder.—*Talc.*
Twenty-five miles from B. on the Gunpowder.—*Magnetic iron, sphene*, pycnite.
Eight to ten miles north of B.—*Brown hematite.*
Eight to twenty miles north of B., in limestone.—*Tremolite, augite, pyrites*, brown and yellow tourmaline.
Fifteen miles north of B.—*Sky blue chalcedony* in granular limestone.
Eighteen miles north of B., at Scott's mills.—*Magnetic iron*, kyanite.
Bare Hills.—*Chromic iron, asbestus, tremolite, talc*, hornblende, serpentine, chalcedony, meerschaum.
Cape Sable, near Magothy R.—Amber, pyrites, alum slate.
Catoctin Mts.—Pyritous copper, carbonate of copper.
Cecil county, north part.—*Chromic iron* in serpentine.
Cooptown, Harford Co.—Olive colored *tourmaline, diallage, talc* of green, blue and rose colors, *ligniform asbestus, chromic iron, serpentine.*
Deer Creek.—*Magnetic iron!* chlorite slate.
Liberty.—*Specular iron.*
Meadow Mt.—*Quartz crystals.*
Montgomery Co.—*Peroxyd of manganese.*
Six miles north of the Potomac.—Chromic iron in serpentine, dolomite.
Newmarket, (between Newmarket and Tancytown, east of the Monocaccy.)—*Vitreous copper, copper pyrites, malachite:*
"Soldier's Delight."—Serpentine (kerolite ?) gray antimony.
Somerset and Worcester Cos., north part.—*Bog iron, Vivianite.*
St. Mary's River.—*Gypsum!* in clay.

VIRGINIA AND DISTRICT OF COLUMBIA.

Albemarle Co., a little west of the Green Mts.—*Steatite.*
Amherst Co., along the west base of Buffalo ridge.—*Copper ores*, &c
Buckingham Co., Willis's Mt.—*Kyanite, tourmaline, actinolite.*
Eldridge's Gold mine.—*Gold, auriferous pyrites, heavy spar.*
Culpepper Co., on Rapidan River.—Gold, pyrites.
Franklin Co.—Grayish steatite.
Fauquier Co., Barnet's mills.—Asbestus.
Phenix Copper Mines.—*Copper pyrites*, &c.
J. Hood's plantation.—*Heavy spar.*
Georgetown, D. C.—Rutile.
Loudon Co.—*Tabular quartz, prase, pyrites, talc, chlorite, soapstone*, asbestus, *chromic iron, actinolite, quartz crystals.*
Louisa Co., near Tinder's Gold mine.—Brown iron ore.
Luzerne Co., Walton gold mine.—*Gold, pyrites*, copper pyrites, argentiferous galena, spathic iron, blende, anglesite.
Orange Co., western part, Blue Ridge.—Specular iron.
U. S. Copper Mine District.—Vitreous copper.
Greenwood Gold Mines.—Gold.
Rockbridge Co., three miles southwest of Lexington.—Heavy spar.
Shenandoah Co., near Woodstock.—Fluor spar.
Mt. Alto, Blue ridge.—Argillaceous iron ore.
Spotsylvania Co., two miles northeast of Chancellorville.—*Kyanite.*

Wythe Co., (Austin's mines.)—*White lead ore, minium, plumbic ochre,* blende, *electric calamine, galena.*

Spotsylvania Co., eighteen miles above Fredericksburg, on the Rappahannock.—Gold.

Stafford Co., eight or ten miles from Falmouth.—Micaceous iron, gold, silver, galena, vivianite.

Washington Co., eighteen miles from Abingdon.—*Rock salt,* with *gypsum.*

Wier's Cave and other caves in Virginia.—*Calc spar* and *stalactites.*

Kenawha.—Petroleum.

Shepardstown.—Fluor spar.

NOTE.—The minerals usually associated with the gold are, arsenical iron, iron and copper pyrites, carbonate of copper, blende, galena, phosphate of lead in crystals, sulphur, peroxyd of iron, and rarely oxyd of tin and bismuth. (ROGERS.)

SOUTHERN STATES.—NORTH CAROLINA.

Buncombe Co.—*Zircon!* rutile in quartz, nitrogen, from a warm spring.

Cabarras Co.—*Gold;* also in Burke, Lincoln, Rutherford, and Mecklenburg Cos.—Phosphate copper, malachite.

Rutherford Co., on the road to Cooper's Gap.—Kyanite.

Davidson Co., (King's mine.)—*Lamellar native silver, carbonate of lead! pyromorphite!* galena, blende, malachite, black copper, oxyd of iron and manganese.

SOUTH CAROLINA.

Elbert Co., Petersburg.—Radiated talc.

Hall Co.—*Native gold,* argentiferous gold, quartz, kaolin.

Hancock Co.—Agate, chalcedony.

Lumpkin Co.—Native gold, quartz crystals.

Richmond Co., Augusta.—Jet.

Wilkes Co.—Yellow ochre.

GEORGIA.

Burke and Scriven Cos.—Hyalite.

Gold District.—*Native gold,* native silver, iron and copper pyrites, magnetic iron, hornblende, garnet, hepatic pyrites, rutile, tourmaline, zircon, staurotide.

Rayburn.—Copper pyrites.

Habersham, head of Mill Creek.—*Galena.*

WESTERN STATES.—OHIO.

Bainbridge, (Copperas Mt., a few miles east of B.)—Calc spar, heavy spar, iron pyrites, copperas, alum.

Canfield.—*Gypsum!*

Duck Creek, Monroe Co.—Petroleum.

Liverpool.—Petroleum.

Marietta.—Argillaceous iron ore; iron ore abundant, also in Scioto and Lawrence Cos.

Poland.—*Gypsum!*

ARKANSAS.

Wachita Springs.—*Quartz!*

MICHIGAN.

Range of hills, from Lake Superior, a few miles west of Chocolate river, running southwest across the Upper Peninsula.—Galena, pyritous copper, vitreous copper in narrow veins.

Westwardly from Kewena pt., Lake Superior, through a region one to seven miles wide, 135 miles, an extensive mining district, containing *malachite, chrysocolla, oxyd of copper,* native silver, sulphuret of silver, *native copper!* In the trap of this region, *Prehnite!!* various *zeolites!!* not yet distinguished.*

Isle Royal, Lake Superior.—*Malachite,* &c.

ILLINOIS.

Gallatin Co., on a branch of Grand Pierre Creek, 16 to 30 miles from Shawneetown, down the Ohio, and from 3 to 8 miles from this river.—*Violet fluor spar!* heavy spar, galena blende, brown iron ore.

In Northern Illinois, townships 27, 28, 29, several important mines of *galena.*

INDIANA.

Limestone caverns.—*Epsom salt;* in most of the S. W. counties, *pyrites, sulphate of iron,* and *feather alum;* on Sugar Creek, pyrites and *sulphate of iron!;* in sandstone of Floyd Co., near the Ohio, *gypsum;* at the top of the blue limestone formation, *brown spar! calc spar.*

WISCONSIN.

At Mineral Point and elsewhere copper and lead ores abundant, principally carbonate of copper and galena. Also pyrites, capillary pyrites, blende, white lead ore, calamine, anglesite, heavy spar, and calc spar; often in highly interesting forms.

IOWA.

Du Buque Lead Mines, and elsewhere.—*Galena! calc spar,* black oxyd of manganese; at Ewing's and Sherald's diggings, *calamine!;* at Des Mains, quartz crystals; Mahoqueta R., *brown iron ore.*

MISSOURI.

Jefferson Co., at Valle's diggings.—*Calamine, galena, white lead ore,* anglesite, pyritous copper, blue and green malachite.

Mine à Burton.—*Galena, white lead ore, anglesite, heavy spar,* calc spar.

Deep Diggings.—Carbonate of copper, *white lead ore* in crystals, black earthy cobalt, and manganese ore.

Mine La Motte.—Malachite, earthy cobalt and manganese, *white lead ore* in crystals.

Perry's Diggings, and elsewhere.—Galena, &c.

Forty miles west of the Mississippi and ninety south of St. Louis, the Iron mountains.

KENTUCKY.

Mammoth Cave.—*Gypsum* in imitative forms, stalactites, nitre, epsom salt.

TENNESSEE.

Brown's Creek.—Galena, blende, heavy spar, celestine.

Carter Co., foot of Roan Mt.—*Sahlite,* magnetic iron.

Claiborne Co.—*Calamine,* galena, electric calamine, chlorite, steatite, and magnetic iron.

Davidson Co.—Selenite with granular and snowy *gypsum,* or alabaster, crystallized and compact *anhydrite. fluor* in crystals! *calc spar* in crystals. Near Nashville, blue *celestine* (crystallized, fibrous and radiated,) with *heavy spar* in limestone. Haysboro, galena, blende, with heavy spar as the gangue of the ore.

Dickson Co.—Manganite.

Jefferson Co.—*Calamine,* galena, fetid heavy spar.

Knox Co.—Magnesian limestone.

Maury Co.—Wavellite in limestone.

Morgan Co.—Epsom salt, nitrate of lime.

Roan Co., eastern declivity of Cumberland Mts.—Wavellite in limestone.

Severn Co., in caverns.—Epsom salt, soda, alum, saltpetre, nitrate of lime.

Smith Co.—Fluor.

White Co., Sparta, about the Calf Killer's Creek.—A rolled fragment of sulphuret of silver, fluor, liquid bitumen.

Stone Creek, near Mr. Holland's.—Iron ore, black oxyd of manganese.

Smoky Mt., on declivity.—Hornblende, garnet, staurotide.

PART VI.

CHEMICAL CLASSIFICATION.

THE classification which has been adopted in the Descriptive part of this treatise has been explained as being strictly a chemical arrangement, although still a Natural system, (§§ 115, 118.) It takes into view, it is true, the external characters; but as these depend upon the chemical constitution, and proceed from it, they are indications of the composition, and unless followed too implicitly and without a general survey of the whole subject, will not lead to important variations from a strict chemical method. It has been shown that owing to the isomorphism of bases, the old modes of chemical classification are wholly unsatisfactory; and the difficulties have of late become so great that some authors have fallen into an alphabetical arrangement, rather than be bound down to the usual chemical rules. Moreover, it has been remarked that the union of the salts of the metals into a family is more correct on chemical principles than a distribution of them under the several metals: and that as the salts of lime, magnesia, alumina, are also salts of metals, the former fall naturally and chemically into close associations with the latter, as in the system adopted.

Yet it is convenient to the chemist and to the metallurgist, to view the ores of the several metals by themselves, and in general to be able to survey at a glance the compounds of each element. For this purpose, the following classification has been made out. Except in the metallic ores, the mineral species have been kept together, as much as possible, in natural families, by taking into consideration the isomorphous relations of the elements; and it is believed that the classification here proposed will be found to combine many of the more important advantages of both systems. *Chemists* treat of the alums as a family, of the various feldspars as another, and the varieties of hornblende and augite as another, and so on; and instead of scattering them in different parts of a system, as was formerly done, arrange them together and treat of them as distinct groups, although differing so much in chemical constitution. These natural families are still retained in the method of arrangement here brought forward.

We add to the table, formulas for the chemical constitution of the mineral species, stating generally, authorities, and also referring in many instances to particular analyses; and when authorities vary essentially, two or more formulas are given. The very elaborate treatise on Chemical Mineralogy by Rammelsberg, which has lately appeared in Germany,* has afforded

* Handwörterbuch des Chemischen Theils der Mineralogie, von C. F. Rammelsberg: 2 vols. 8vo. pp. 442 and 326: Berlin, 1841.—And, Erstes Supplement, (first supplement to the same,) 8vo. pp. 156: Berlin, 1843. This supplement is to be continued biennially.

nearly all the materials for this part of the Table. The chemical symbols are deemed preferable to the mineralogical, inasmuch as they convey to the eye more readily the exact constitution of the species.

In place of the crossed letters introduced by Berzelius for double atoms, the black type (**H**, for example) has been employed; and the facility of obtaining this kind of letter at the type foundries, as well as their peculiar fitness for the purpose, recommends them for general use.

The following are the symbols as used for the elements, arranged alphabetically:

Aluminium,	**Al.**	Manganese,	Mn.
Antimony, (Stibium,)	**Sb.**	Molybdenum,	Mo.
Arsenic,	**As.**	Nickel,	Ni.
Barium,	Ba.	Nitrogen,	**N.**
Bismuth,	Bi.	Osmium,	Os.
Boron,	B.	Palladium,	Pd.
Bromine,	**Br.**	Phosphorus,	**P.**
Cadmium,	Cd.	Platinum,	Pt.
Calcium,	Ca.	Potassium, (Kalium,)	K.
Carbon,	C.	Quicksilver, (Hydrargyrum,)	Hy.
Cerium,	Ce.	Rhodium,	R.
Chlorine,	**Cl.**	Selenium,	Se.
Chromium,	Cr.	Silicon,	Si.
Cobalt,	Co.	Silver, (Argentum,)	Ag.
Columbium, (Tantalum,)	Ta.	Sodium, (Natrium,)	Na.
Copper, (Cuprum,)	Cu.	Strontium,	Sr.
Fluorine,	**Fl.**	Tantalum, see Columbium.	
Glucinum, (Beryllium,)	**Be.**	Tellurium,	Te.
Gold, (Aurum,)	Au.	Thorium,	Th.
Hydrogen,	**H.**	Tin, (Stannum,)	St.
Iodine,	**I.**	Titanium,	Ti.
Iridium,	Ir.	Tungsten, (Wolframium,)	W.
Iron, (Ferrum,)	Fe.	Uranium,	U.
Lanthanum,	La.	Vanadium,	V.
Lead, (Plumbum,)	Pl.	Yttrium,	Y.
Lithium,	Li.	Zinc,	Zn.
Magnesium,	Mg.	Zirconium,	**Zr.**

Principal binary compounds of the elements with oxygen.

Alumina,	**Al.**	Oxyd of Cobalt,	Co.
Arsenic acid,	**As.**	Oxyd of Copper,	Cu.
Baryta,	Ba.	Glucina,	**Be.**
Oxyd of Bismuth,	Bi.	Protoxyd of Iron,	Fe.
Boracic acid,	B.	Peroxyd of Iron,	**Fe.**
Protox. Cerium,	Ce.	Oxyd of Lead,	Pb.
Perox. Cerium,	**Ce.**	Lithia,	L.
Carbonic acid,	C.	Magnesia,	Mg.
Chromic acid,	Cr.	Protox. Manganese,	Mn.

Perox. Manganese,	Mn.	Oxyd of Tin,	Sn.
Molybdic acid,	Ṁo.	Titanic acid,	Ti.
Oxyd of Nickel,	Ṅi.	Tungstic acid,	W⃛.
Nitric acid,	N.	Oxyd of Uranium,	Ü.
Phosphoric acid,	P.	Water,	Ḣ.
Potash,	K.	Yttria,	Ẏ.
Silica,	S⃛i.	Oxyd of Zinc,	Żn.
Soda,	Ṅa.	Zirconia,	Z̈r.
Strontia,	Ṡr.		

In the following table, when several bases are included in brackets, after which an index is placed, as for example, Pyroxene on page 556, the index (as ^{3} in this case) is to be considered as the index of each of the included bases.

CLASS I. GASES AND LIQUIDS.

Hydrogen (211.)
Carburetted Hydrogen (211.)
Phosphuretted Hydrogen (211.)
Sulphuretted Hydrogen (212.)
Nitrogen (212.)
Atmospheric air (212.)
Water (213)=$\mathbf{H}$.

CLASS II. ACIDS.

Carbonic acid (212)=C
Sulphuric acid (213)=S
Sulphurous acid (213)=S.
Muriatic acid (213)=$\mathbf{H}\ Cl$
Boracic acid (214)=$B+3\mathbf{H}$
Arsenous acid (214)=As

CLASS III. COMPOUNDS OF THE ALKALIES AND EARTHS, WITH THE SAPID ACIDS.

Family 1. Ammonia.

Sal Ammoniac (222)=$N\ \mathbf{H}^3+Cl\mathbf{H}$.
Mascagnine (222)=$N\ H^3S+2\mathbf{H}$.

Family 2. Potassa.

Nitre (224)=$K\ \mathbf{N}$

Family 3. Soda.

Glauber's salt (220)=$NaS+10\mathbf{H}$—Exanthalose of Beudant, $NaS+2\mathbf{H}$.
Thenardite (221)=NaS
Nitrate of Soda (223)=$Na\mathbf{N}$
Natron (21[illegible]$C+10\mathbf{H}$
Trona (219)=$Na^2C^3+4\mathbf{H}$
Gay Lussite (218)=$NaC+CaC+6\mathbf{H}$, (Ramm., from Boussingault's late analysis.)
Common Salt (219)=$NaCl$

Borax (215) = $NaB^2 + 10H$.

Glauberite (228) = NaS + CaS

Family 4. BARYTA.

Heavy Spar (257) = BaS.

Dreelite (256) = CaS + 2BaS.

Witherite (256) = BaC.

Barytocalcite (255) }
Bromlite (255) } = BaC + [illegible]

Sulphato-Carbonate of B (258) = 2BaC + BaS

Family 5. STRONTIA

Celestine (254) = SrS

Strontianite (253) = SrC.

Family 6. LIME

Nitrate of Lime (223) = CaN + H.

Gypsum (240) = CaS + [illegible]

Anhydrite (241) = CaS

Calcareous Spar (243) }
Arragonite (246) } = CaC

Dolomite (24[illegible]) = [illegible]C + MgC, a 2d = 3CaC + 2MgC; a 3d = 2CaC + MgC, a 4th (Conite) = CaC + 3MgC, (Berthier.)

Ankerite (249) = 2(Fe,Mn)C + 3MgC + 5CaC

Apatite (237) = Ca(Cl,Fl) + $3Ca^3$P, or is phosphate of lime combined with either chlorid of calcium or fluorid of calcium, or both, (Ramm.)

Tungstate of Lime (260) = CaW

Pyrochlore (434) Columbate of Lime (according to Hayes) containing as accidental ingredients, Thorium and Cerium

Fluor Spar (236) = CaFl

Haidingerite (240) = $Ca^2As + 4H$

Pharmacolite ([illegible]) = $Ca^2As + 6H$.

Oxalate of Lime (230) = CaC + H.

Hydroboracite (242) = $Ca^3B^4 + Mg^3B^4 + 18H$. CaB + MgB + 6H, (Berzelius.)

Borate of Lime ([illegible])

Family 7. MAGNESIA.

Epsom Salt (221) = MgS + 7H.

Nitrate of Magnesia (22[illegible])

Polyhalite (228) =KS+MgS+2CaS+2**H**. (Stromeyer's Anal.)

Magnesite (249)=MgC

Hydromagnesite (250)=3(MgC+**H**)+Mg**H**. (Ramm.)

Boracite (405)=Mg^2B^4—perhaps MgB^2+2MgB. (Arfvedson.)

Rhodizite (406.)

Wagnerite (231)= 2MgFl+5Mg^3**P** (Berz.)—MgFl+3Mg^3**P**, (Rammelsberg, who suggests that it may be a magnesia-apatite.)

Family 8. ALUMINA.

Feather Alum (215)=**Al**S^3+18**H**

Native Alum (216)=KS+**Al**S^3+24**H**

Soda Alum (216)=NaS+**Al**S^3+24**H**

Ammonia Alum (217)=**NH**^{4}S+**Al**S^3+24**H**

Magnesia Alum (216)=MgS+**Al**S^3+24**H** (Mg,Mn)S+**Al**S^3+24**H**. (African alum analyzed by Stromeyer.) The Pickeringite of Hayes is probably identical with this variety.

Iron Alum (217)=FeS+**Al**S^3+24**H**

Manganese Alum (217)=MnS+**Al**S^3+24**H**

Voltaite (533)=3(Fe, K, Na)S+2(**F**e, **Al**)S^3+12**H** (Rammelsberg, from Abich's analysis.)

Websterite (231)=**Al**S+9**H**

Alum Stone (232)=K^3S+12**Al**S+24**H**, (Berz. from Cordier's Anal.)—KS+3**Al**S+6**H** (Berthier, who has lately analyzed the Hungarian Alum-stone examined by Klaproth.)

Pissophane (232)=**R**^{2}S+15**H**, (Erdmann.)

CLASS IV. EARTHY MINERALS.

Family 1. SILICA.

Quartz (408)=Si

Opal (414)=Si^3+**H**(?) opal from Hungary.

Family 2. LIME.

Tabular Spar (361)=Ca^3Si^2

Edelforsite of Kobell (337)=CaSi

Dysclasite (335)=Ca^3Si^4+6**H**.

Datholite (342)=2Ca^3Si+B^3Si^2+3**H**. (Ramm.) Botryolite=2Ca^3Si+B^3Si^2+6**H** (Ramm.)

Family 3. MAGNESIA

1. *Pure*

Periclase (405)=Mg. (Rammelsberg, from Scacchi's analysis.)

2. *Simple hydrate or silicate of magnesia*

Brucite (388)=$Mg\mathbf{H}$

Boltonite (345)=Mg^3Si^2(?) (Kobell.)

Pyrallolite (308)=Mg^3Si^2

Talc (315)=$MgSi$

3. *Hydrous silicates of magnesia, or silicates of magnesia and the bases isomorphous with it.*

Aphrodite (309)=$Mg^3Si^2+2\mathbf{H}$ (?) (Ramm. from Berlin's analysis.)

Meerschaum, (308)=$MgSi+\mathbf{H}$, (Lychnell's Analysis.)

Saponite (316)=$2Mg^3Si^2+\mathbf{Al}Si+10\mathbf{H}$ (Ramm.)

Dermatine (310)=$(Mg, Fe)^3Si^2+6\mathbf{H}$

Chlorite (317)=$(Mg, Fe)Si+(\mathbf{Al}, \mathbf{Fe})Si+1Mg\mathbf{H}$, (Kobell.) $2Mg^2Si+Mg\mathbf{Al}+4\mathbf{H}$, (Berz.) $(Mg, Fe)^3Si+\mathbf{Al}Si+2Mg\mathbf{H}^2$, (Varrentrapp.)

Ripidolite (317)=$2Mg^2Si+Mg^2\mathbf{Al}+3\mathbf{H}$, (Berz.) $(Mg, Fe)^3Si+\mathbf{Al}Si+3Mg\mathbf{H}$, (Varrentrapp.)

P[illegible], $Fe)^3Si^2+\mathbf{Al}Si^2+7Mg\mathbf{H}$; (Schweizer.)

Nemalite (313)=$Mg^3Si+6Mg\mathbf{H}^2$(?)

Villarsite (311)=$4(Mg, Fe)^3Si+\mathbf{H}$, or it is a hydrous olivine.

Hydrous Anthophyllite (312.)

Picrophyll, (311)=$(Mg, Fe)^3Si^2+2\mathbf{H}$

Picrosmine (312)=$2Mg^3Si^2+3\mathbf{H}$

Serpentine (309)=$2Mg^3Si^2+3Mg\mathbf{H}^2$, (Mosander and Lychnell.) $Mg^2\mathbf{H}Si$, with some $Mg\mathbf{H}$, (Frankenheim.)

Retinalite (310)=$2NaSi+Mg^6Si+6\mathbf{H}$(? v. Kobell.)

Antigorite (314)=$(Mg, Fe)^3Si^2+Mg\mathbf{H}$, (Schweizer.)

Schiller Asbestus (310)=$Mg^3Si^2+Mg\mathbf{H}^3$(?) Same with serpentine according to Frankenheim.

Kerolite (311)=$Mg^3Si^2+\mathbf{Al}Si+15\mathbf{H}$. A late analysis of the Kerolite from Zoblitz, gives a different formula, $2(Mg^3Si^2+2\mathbf{H})+Mg\mathbf{H}$, or nearly that of Serpentine.

Schiller Spar (313)=$4(Ca, Mg, Fe)^3Si^2+3Mg\mathbf{H}^4$. The Schiller Spar from Baste has the same formula as given by Frankenheim for Serpentine, according to Kohler's analysis.

Clintonite (314) = (Mg, Ca, Fe) $Si + (Mg, Ca, Fe)^3 Al^2 + H$, (Ramm.) For Xanthophyllite, which is identical with Clintonite according to Rose, this chemist gives the formula $2RSi + 6RAl + RH^3$.

Leuchtenbergite (317) = $R^3 Si^2 + R^2 R + 3H$, (Ramm., Komonen's analysis.)

Pyrallolite (308) = $Ca^3Si^1 + 6Mg^3Si^2 + AlSi^2 + 6H$.

Pyrosclerite (530) = $2(Mg, Fe)^3Si + (Al, Cr)Si + 1\frac{1}{2}H$

1. *Anhydrous silicates of magnesia and their isomorphous compounds.*

Pyroxene (364) = R^3Si^2, or $(Ca, Mg, Fe, Mn)^3Si^2$

Bronzite (366) = Mg^3Si^2

Hypersthene (366) = $(Mg, Fe)^3Si^2$

Bustamite (363) = $(Ca, Mn)^3Si^2$

Hedenbergite (365) = $(Ca, Fe)^3Si^2$

Diallage (366) = $(Ca, Mg, Fe)^3Si^2$

Acmite (373) = $(Fe, Na)^3Si^2$, (according to Frankenheim.)

Polylite (367) = $(Fe, Ca, Mn)^3(Si, Al)^2$ (v. Kobell.) Probably a variety of Augite closely allied to Hedenbergite, and the Hudsonite of Beck is nearly identical with it.

Hornblende (368) = $R Si + R^3Si^2$, or R^4Si^3

Tremolite (369) = $(Mg, Ca)^4Si^3$

Anthophyllite (372) = $(Fe, Mg)^4Si^3$, or Mg^4Si^3

Arfvedsonite (370) = $NaSi + Fe^3Si^2$, or Fe^4Si^3 with part of the oxyd of iron replaced by Soda.

Cummingtonite (373) = $NaSi + {}^3(Fe, Mn)Si$ (?) Another analysis required; probably falls within the Hornblende series.

Babingtonite (368) = $3CaSi + Fe^3Si^2$, (Ramm. from Arpe's analysis.)

Breislakite (375.)

Chrysolite (403) = $(Mg, Fe)^3Si$. Batrachite = $(Ca, Mg, Fe)^3Si$

Forsterite (403.)

Nephrite (344) = $3Mg^2Si + (Al, Fe)Si$. A doubtful compound.

Chondrodite (388) = $MgFl + 3Mg^3Si$, (Ramm.)

Family 4. ALUMINA.

1. *Pure or hydrous, or combined with bases.*

Sapphire (398) = Al

Gibbsite (304) = AlH^3

Hydrargillite (304) hydrate of alumina, (?) Rose.—See Kammererite among the *addenda* on a following page.

Diaspore (377)=**AlH**.

Spinel (395)=Mg**Al**. Pleonaste=(Mg, Fe) **Al**.

Automolite (397)=(Zn, Mg, Fe) **Al**, (Abich.)

Dyslüite (397)=(Zn, Fe, Mn) (**Al**, **Fe**,) (Ramm.)

Sapphirine (399)=**Al**Si+3Mg**Al**, (v. Kobell)

2. *Combined with Phosphoric, Fluoric or Mellic Acid*

Mellite (231)=**Al** $\bar{M}^3$+18**H**.

Wavellite (233)=**Al**Fl^3+3(**Al**^{4}**P**^{3}+18**H**.)

Childrenite (235)

Fluellite (234.)

Turquois (346)=(**Al**^{4}**P**^{3}+9**H**)+2**Al**H^3.

Lazulite (317)=3Mg**P**^{2}+4**Al**^{4}**P**^{3}+15**H**, (v Kobell)

Amblygonite (374)=L^2**P**+**Al**^{4}**P**^{3}, (Berz.)

Cryolite (231)=3Na**Fl**+**Al**Fl^3, (Berz.)

Topaz (401)=(**Al**+2**Al**Fl^3)+6**Al** Si, (Berz.;) and Pycnite=**Al** Fl^3 +3**Al**Si, (Berz.) Later by Forchhammer, Topaz=2**Al**Fl^3+5**Al**Si, and Pycnite, 2**Al**Fl^3+**Al**^{3}Si^2.

3. *Hydrous Silicates.*

Pholorite (301)= **Al**Si+2**H**.

Kollyrite (301)=**Al**^{3}Si+15**H**. (Berthier's anal.) **Al**^{3}Si^2+5**H**, (Kers.)

Halloylite (301)=2**Al**Si^2+**Al** H^2, (Guatemala, Bouss.) (**Al**Si^3+3**H**) +**Al** H^3, (? Housscha, Berthier.) Cimolite=**Al** Si^3+3**H**, (Klaproth's analysis.)

Allophane (303)=**Al**^{3}Si^2+15**H**, (from Gersbach.) That from Schneeberg is mixed with Cu^{3}Si^2+6**H**; and a variety from Graffenthal contains 20**H** instead of 15**H**, (Gerhardt.)

Rosite (302)=R^{3}Si^2+6**Al**Si+6**H**, (Svanberg.)

Pyrargillite, (302)=(Fe, Mn, Mg, Na, K) Si+**Al**Si+4**H**, (Berz.)

Pyrophyllite. (318)=Mg^{3}Si^2+9**Al**Si^2+9**H**.

Wœrthite (376)=5**Al** Si+**Al** H^3.

Praseolite (530)=(Mg, Fe)^{3}Si+2**Al**Si+3**H**, (Ramm., Erdmann's analysis.)

Hydrous Mica (324.).

Chloritoid (523)=(Fe, Mg)^{3}Si+**Al**^{2}Si=9**H**, (Bonsdorff.)

Fahlunite (305) = $(\dot{Mg}, \dot{Mn}, \dot{Fe}, \dot{K}, \dot{Na})^3 \ddot{Si}^2 + 3(\dot{Al}, \dot{Fe})\, Si + 6\dot{H}$, (Ramm.)

Esmarkite (306) = $(\dot{Mg}, \dot{Fe}, \dot{Mn})^3\ddot{Si}^2 + 3\ddot{Al}\ddot{Si} + 3\dot{H}$.

Chlorophyllite (306) = $(\dot{Mg}, \dot{Fe})^3\ddot{Si}^2 + 3\ddot{Al}\ddot{Si} + 2\dot{H}$.

Gigantolite (307) = $\dot{R}\, Si + \dot{Al}\ddot{Si} + \dot{H}$, (Trollé Wachtmeister.)

Glottalite (525) = $Ca^3\ddot{Si}^2 + AlSi + 9\dot{H}$.

Heulandite (324) = $3\dot{Ca}Si + 4\ddot{Al}\ddot{Si}^3 + 18\dot{H}$ ($21\dot{H}$ in some specimens,) (Ramm.)

Brewsterite (325) = $5(\dot{Ba}, \dot{Sr})\ddot{Si} + 3\ddot{Al}^2\ddot{Si}^5 + 25\dot{H}$, from Connell's analysis, (Ramm.)

Laumonite (326) = $Ca^3Si^2 + 4AlSi^2 + 18\dot{H}$, (Berz.) $\dot{Ca}^3\ddot{Si}^2 + 3\dot{Al}Si^2 + 12\dot{H}$, (Gerhardt.)

Apophyllite (327) = $\dot{K}\, Si^2 + 8\dot{Ca}Si + 16\dot{H}$, (Berz.) Perhaps $(\dot{Ca}, \dot{K})Si + 2\dot{H}$, (Ramm.)

Stilbite (328) = $\dot{Ca}Si + AlSi^3 + 6\dot{H}$. The Edelforsite or red zeolite of Ædelfors, according to Retzius, has the formula $\dot{Ca}\ddot{Si} + \ddot{Al}\ddot{Si}^3 + 4\dot{H}$.

Epistilbite (329) = $(\dot{Ca}, \dot{Na})Si + 3Al\ddot{Si}^3 + 5\dot{H}$.

Thomsonite (330) = $[\dot{Na}^3Si + 3\dot{Al}Si + 3\dot{H}] + [3(\dot{Ca}^3\ddot{Si} + 3\dot{Al}\dot{Si} + 9\dot{H})]$, (Berz.) $(Ca, Na, K)^3Si + 3AlSi + 7\dot{H}$, (Ramm.)

Edingtonite (330) = $(\dot{Ca}, \dot{Na})^3Si + 2\ddot{Al}\dot{Si} + 6\dot{H}$.

Harmotome (331) = $2(\dot{Ba}, \dot{K})^3Si^4 + 7\dot{Al}Si^2 + 36\dot{H}$, (Köhler.) $\dot{Ba}^3\ddot{Si}^2 + 4AlSi^2 + 18\dot{H}$, (Kobell, and later Ramm.)

Phillipsite (332) = $(\dot{K}, \dot{Ca})^3Si^2 + 4\ddot{Al}\dot{Si}^2 + 18\dot{H}$, (Köhler.)

Faujasite (524) = $(\dot{Ca}, \dot{Na})^3\ddot{Si}^4 + 3\ddot{Al}\ddot{Si}^2 + 24\dot{H}$, (Damour.)

Natrolite, or Soda-Mesotype (332) = $\dot{Na}\ddot{Si} + \ddot{Al}Si + 2\dot{H}$.

Scolecite, or Lime-Mesotype (335) = $\dot{Ca}\ddot{Si} + \ddot{Al}Si + 3\dot{H}$.

Poonahlite (333) = $3\dot{Ca}\ddot{Si} + 5\dot{Al}\ddot{Si} + 12\dot{H}$; or $[\dot{Ca}\ddot{Si} + \ddot{Al}\ddot{Si} + 3\dot{H}]$ $[2(\dot{Ca}Si + 2\ddot{Al}\dot{Si} + 5\dot{H})]$ (the first part of which is Scolecite, Ramm.)

Mesole (334) = $[\dot{Na}^3\ddot{Si}^2 + 3\dot{Al}\ddot{Si} + 6\dot{H}] + [\dot{Ca}^3\ddot{Si}^2 + 5\ddot{Al}\ddot{Si} + 6\dot{H},]$ (from Annaklef.) $[\dot{Na}^3\ddot{Si}^2 + 3AlSi + 6\dot{H}] + [2(\dot{Ca}^3\ddot{Si}^2 + 3\ddot{Al}\ddot{Si} + 9\dot{H},)]$ (from Faroe.) $(\dot{Na}, \dot{Ca})^3Si^2 + 3\ddot{Al}\dot{Si} + 8\dot{H}$, (Ramm.)

Brevicite (334) = $(\dot{Na}, \dot{Ca})^3Si^2 + 3\ddot{Al}\ddot{Si} + 6\dot{H}$, (Berz.)

Pectolite (334) = $3(\dot{Na}, \dot{K})\ddot{Si} + 4\dot{Ca}^3\ddot{Si}^2 + 3\dot{H}$. According to Frankenheim, Ca^4Si^3, with some soda replacing part of the lime, and thus allied to Hornblende.

Mesolite (335) = $[\dot{Na}\ddot{Si} + \dot{Al}\ddot{Si} + 2\dot{H}] + [2(\dot{Ca}\ddot{Si} + \ddot{Al}\ddot{Si} + 3\dot{H}.)]$ A compound of Natrolite and Scolecite in varying proportions.

Stellite (336) $= 5(\dot{C}a, \dot{M}g, \dot{F}e)^3\ddot{S}i^2 + \ddot{A}l\ddot{S}i + 6\dot{H}$, (Ramm.)

Analcime (337) $= \dot{N}a^3\ddot{S}i^2 + 3\ddot{A}l\ddot{S}i^2 + 6\dot{H}$.

Chabazite and Gmelinite (340) $= (\dot{C}a, \dot{N}a, \dot{K})^3\ddot{S}i^2 + 3\ddot{A}l\ddot{S}i^2 + 18\dot{H}$.—Common chabazite is *lime-chabazite*, and Gmelinite a *soda-chabazite*. $(\dot{C}a, \dot{N}a, \dot{K})\ddot{S}i + \ddot{A}l\ddot{S}i^2 + 6\dot{H}$, (some varieties; Ramm.)

Acadiolite, (341) according to Thomson's analysis, has the formula $\dot{C}a^3 \ddot{S}i^4 + 2\ddot{A}l\ddot{S}i^2 + 18\dot{H}$, (Rammelsberg.)

Phacolite (341) $= 3(\dot{C}a, \dot{N}a, \dot{K})\ddot{S}i + 2\ddot{A}l\ddot{S}i + 9\dot{H}$, (Anderson.)—$\dot{R}^2\ddot{S}i^3 + 2\ddot{A}l\ddot{S}i + 10\dot{H}$, or perhaps $\dot{R}\ddot{S}i + \ddot{A}l\ddot{S}i^2 + 6\dot{H} + (\dot{R}\ddot{S}i + \ddot{A}l\ddot{S}i + 4\dot{H},)$ corresponding to a compound of chabazite with scolecite, subtracting one atom of water, (Ramm.)

Haydenite (342 and 526.)

Carpholite (375) $= (\dot{M}n, \dot{F}e)^3\ddot{S}i + 3\ddot{A}l\ddot{S}i + 6\dot{H}$.

Prehnite (343) $= \dot{C}a^2\ddot{S}i + \ddot{A}l\ddot{S}i + \dot{H}$, (Walmstedt.)—$2\dot{C}a^3\ddot{S}i + 3\ddot{A}l\ddot{S}i + \ddot{S}i \dot{H}^3$, (Berz.)

Kaolin (350) $= \ddot{A}^3\ddot{S}i^4 + 6\dot{H}$, (Forchhammer.)

4. *Anhydrous Silicates.*

Bucholzite (378) $= \ddot{A}l\ddot{S}i$.

Kyanite (375) $= \ddot{A}l^3\ddot{S}i^2$, (v. Kobell, Bucholz, and Rosales, from St. Gothard.)—$\ddot{A}l^2\ddot{S}i$, (Arfvedson.)

Sillimanite (377) $= \ddot{A}l^3\ddot{S}i^2$, (Connell.)

Andalusite (386) $= \ddot{A}l^4\ddot{S}i$, (Bunsen.)—$\ddot{A}l^3\ddot{S}i^2$, (Kobell.) Kyanite, Sillimanite and Andalusite are inferred, by Berzelius, to be identical in composition, and to have the formula, $\ddot{A}l^3\ddot{S}i^2$.

Staurotide (385) $= (\ddot{A}l, \ddot{F}e)^4\ddot{S}i$, (? Berz.)—$3\ddot{A}l\ddot{S}i + \dot{F}e\ddot{A}l^2$, (v. Kobell.)

Bamlite (522) $= \ddot{A}l^2\ddot{S}i^3$, (Erdmann.)

Sapphirine (399) $= \ddot{A}l\ddot{S}i + 3\dot{M}g\ddot{A}l$, (v. Kobell.)

Leucite (338) $= \dot{K}^3\ddot{S}i^2 + 3\ddot{A}l\ddot{S}i^2$.

Anhydrous Scolecite (355) $= \dot{C}a\ddot{S}i + \ddot{A}l\ddot{S}i$. (Labradorite ?)

Nepheline (347) $= (\dot{K}, \dot{N}a)^2\ddot{S}i + 2\ddot{A}l\ddot{S}i$, (Scheerer.)—$(\dot{K}, \dot{N}a)^3\ddot{S}i + 3\ddot{A}l\ddot{S}i$, (Bromeis.)

Feldspar (348) $= \dot{R}\ddot{S}i + \ddot{R}\ddot{S}i^3$, or $\dot{K}\ddot{S}i + \ddot{A}l\ddot{S}i^3$, (Abich.)

Ryacolite (351) $= (\dot{N}a, \dot{K})\ddot{S}i + \ddot{A}l\ddot{S}i$, (Abich:) the formula is the same as for Labradorite.

Albite (352) $= \dot{R}\ddot{S}i + \ddot{R}\ddot{S}i^3$, or $(\dot{N}a, \dot{K})\ddot{S}i + \ddot{A}l\ddot{S}i^3$, (Abich.)

Andesin (353) $=\dot{R}^3\ddot{Si}^2+3\dddot{\mathbf{R}}\ddot{Si}^2$, (Abich.)

Anorthite (354) $=\dot{R}^3\ddot{Si}+3\dddot{\mathbf{R}}\ddot{Si}$, or $(\dot{Ca}, \dot{Mg}, \dot{K}, \dot{Na})^3\ddot{Si}+3(\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}})\ddot{Si}$, (Abich.)

Labradorite (355) $=\dot{R}\ddot{Si}+\dddot{\mathbf{R}}\ddot{Si}$, or $(\dot{Na}, \dot{Ca})\ddot{Si}+\dddot{\mathbf{Al}}\ddot{Si}$, (Abich.)

Oligoclase (355) $=\dot{Na}\ddot{Si}+\dddot{\mathbf{Al}}\ddot{Si}^2$, (Abich.)

Couzeranite (356) $=(\dot{Ca}, \dot{Mg}, \dot{K}, \dot{Na})\ddot{Si}+2\dddot{\mathbf{Al}}\ddot{Si}$; (Labradorite ?)

Spodumene (360) $=(\dot{Na}, \dot{Li})^3\ddot{Si}^4+4\dddot{\mathbf{Al}}\ddot{Si}^2$, (Berzelius.)

Petalite (360) $=(\dot{Na}, \dot{Li})^3\ddot{Si}^4+4\dddot{\mathbf{Al}}\ddot{Si}^4$, (Berz.)

Latrobite (356) $=(\dot{Ca}, \dot{Mn}, \dot{Mg}, \dot{K})^3\ddot{Si}+4\dddot{\mathbf{Al}}\ddot{Si}$, (Ramm.)

Amphodelite (356) $=(\dot{Ca}, \dot{Mg}, \dot{Fe})^3\ddot{Si}+3\dddot{\mathbf{Al}}\ddot{Si}$, (Nordenskiöld.)

Gehlenite (crystallized) (359) $=2(\dot{Ca}, \dot{Mg})^3\ddot{Si}+\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}})^2\ddot{Si}$. According to Frankenheim, $2\dot{R}^3\dddot{\mathbf{Al}}^2+3\dot{R}^3\ddot{Si}^2$, or $\dot{R}^3(\ddot{Si}, \dddot{\mathbf{Al}})^2$.

Humboldtilite (359) $=3\dot{R}^2\ddot{Si}+\dddot{\mathbf{Al}}\ddot{Si}$. According to Frankenheim, $\dot{R}^3\dddot{\mathbf{Al}}^2+5\dot{R}^3\ddot{Si}^2$, or $\dot{R}^3(\ddot{Si}, \dddot{\mathbf{Al}})^2$, the same as for Gehlenite.

Saussurite (345) $=(\dot{Ca}, \dot{Mg}, \dot{Fe}, \dot{Na})^3\ddot{Si}+2\dddot{\mathbf{Al}}\ddot{Si}$, (Boulanger.)

Scapolite—Meionite (357) $=\dot{Ca}^3\ddot{Si}+2\dddot{\mathbf{Al}}\ddot{Si}$; (Ekebergite) $=(\dot{Ca}, \dot{Na})^3\ddot{Si}^2+2\dddot{\mathbf{Al}}\ddot{Si}$. Other scapolites $(\dot{Ca}, \dot{Na})^2\ddot{Si}+2\dddot{\mathbf{Al}}\ddot{Si}$, (Ersby,)—$(\dot{Ca}, \dot{Na})^3\ddot{Si}^2+4\dddot{\mathbf{Al}}\ddot{Si}$, (Petteby,)—$\dot{Ca}^3\ddot{Si}+3\dddot{\mathbf{Al}}\ddot{Si}$, (Tunaberg and Ersby.)

Common Mica (320) $=\dot{K}\ddot{Si}+4(\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}})\ddot{Si}$, (H. Rose,)—a chrome mica from Zillerthal, (Fuchsite,) containing 4 per cent. of oxyd of chrome, affords nearly the formula $\dot{R}\ddot{Si}+3\dddot{\mathbf{Al}}\ddot{Si}$, (Ramm.)

Hexagonal Mica (322) $=(\dot{K}, \dot{Mg}, \dot{Fe})^3\ddot{Si}+(\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}})\ddot{Si}$, (H. Rose.)

Rhombic Mica (from Henderson, N. Y.) (322) $=3\dot{R}^3\ddot{Si}+2\dddot{\mathbf{R}}\ddot{Si}$, (Meitzendorf;) or, including the fluorine, the same, with $\mathbf{KFl}$, (Ramm.)

Lepidomelane (322) $=(\dot{Fe}, \dot{K})^3\ddot{Si}+3(\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}})\ddot{Si}$.

Lithia Mica (323) $=(K, Li, Na)\mathbf{Fl}+(\dddot{\mathbf{Al}}, \dddot{\mathbf{Mn}})\ddot{Si}^2$, (H. Rose.)

Margarite (320.)

Pinite (304) $=(\dot{K}, \dot{Mg}, \dot{Fe})\ddot{Si}+\dddot{\mathbf{Al}}\ddot{Si}$.

Idocrase (381)
Garnet (382) } $=\dot{R}^3\ddot{Si}+\dddot{\mathbf{R}}\ddot{Si}$. The principal varieties of garnet have the formulas $\dot{R}^3\ddot{Si}+\dddot{\mathbf{Al}}\ddot{Si}$, $\dot{R}^3\ddot{Si}+\dddot{\mathbf{Fe}}\ddot{Si}$, $\dot{Ca}^3\ddot{Si}+\dddot{\mathbf{R}}\ddot{Si}$, $\dot{Mn}^3\ddot{Si}+\dddot{\mathbf{R}}\ddot{Si}$; and these are mixed in various proportions.

Pyrope (384.)

Epidote (379) $=(\dot{Ca}, \dot{Fe})^3\ddot{Si}+2(\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}}, \dddot{\mathbf{Mn}})\ddot{Si}$. Gerhardt gives the following formulas for the three varieties included under this species; for *zoisite* (lime epidote) $2\dot{Ca}^3\ddot{Si}+5(\dddot{\mathbf{Al}}, \dddot{\mathbf{Fe}})\ddot{Si}$; for *common epidote* (lime and

iron epidote) $\dot{C}a^3\ddot{S}i+4(\ddot{\mathbf{A}}\mathbf{l},\ddot{\mathbf{F}}e)\ddot{S}i$, (Vauq. Anal.;) for *magnesian epidote*, $\dot{C}a^3\ddot{S}i+3(\ddot{\mathbf{A}}\mathbf{l}, \ddot{\mathbf{M}}\mathbf{n}, \ddot{\mathbf{F}}e)\ddot{S}i$ (Cordier's Anal.)

Weissite (533)$=(\dot{M}g, \dot{F}e, \dot{M}n, \dot{K}, \dot{N}a)^3\ddot{S}i^2+2\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i^3$.

Tourmaline (389.) A general formula, not yet arrived at.

Iolite (406)$=3(\dot{M}g, \dot{F}e)^3\ddot{S}i^2+8\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i$, (v. Kobell)—$(\dot{M}g, \dot{F}e, \dot{M}n)^3\ddot{S}i+\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i^2$, (Gerhardt,)—$2(\dot{M}g, \dot{F}e)^3\ddot{S}i^2+5\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i$, (Schütz.)

Axinite (407)$=2[(\dot{C}a, \dot{M}g)^3\ddot{S}i+2(\ddot{\mathbf{A}}\mathbf{l}, \ddot{\mathbf{F}}e, \ddot{\mathbf{M}}\mathbf{n})\ddot{S}i]+\ddot{B}\ddot{S}i$, according to which it consists of 2 atoms of epidote and 1 atom of silicate of boron, (Ramm.) More probably, $(\dot{C}a\ \dot{M}g)^3(\ddot{S}i, \ddot{B})^2+2(\ddot{\mathbf{A}}\mathbf{l}, \ddot{\mathbf{F}}e, \ddot{\mathbf{M}}\mathbf{n})(\ddot{S}i, \ddot{B}.)$

Sodalite (338)$=\mathrm{Na}\mathbf{Cl}+\dot{N}a^3\ddot{S}i+3\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i$, (v. Kobell.)

Noscan (339)$=(\dot{\mathbf{N}}a, \dot{C}a)^3(\ddot{S}i, \ddot{S})^2+3\ddot{\mathbf{A}}\mathbf{l}(\ddot{S}i, \ddot{S})$ (?) (Varrentrapp.).

Hauyne (339)$=(\dot{N}a, \dot{C}a)^3(\ddot{S}i, \ddot{S})^2+2\ddot{\mathbf{A}}\mathbf{l}(\ddot{S}i, \ddot{S})$ (Varrentrapp.)—$\dot{C}a^3\ddot{S}i^2+3\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i+2\dot{K}\ddot{S}$, (v. Kobell)—$3(\dot{N}a, \dot{C}a)\ddot{S}+\dot{C}a^3\ddot{S}i^2+4\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i$, (Ramm.)

Family 5. Glucina.

Phenacite (394)$=\dot{B}e^3\ddot{S}i$, (Awdejew.)

Euclase (393)$=\ddot{\mathbf{B}}e\ddot{S}i+2\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i$—Later by Awdejew $2\dot{B}e^3\ddot{S}i+\ddot{\mathbf{A}}\mathbf{l}^2\ddot{S}i$.

Beryl (391)$=\ddot{\mathbf{B}}e\ \ddot{S}i^4+2\ddot{\mathbf{A}}\mathbf{l}\ \ddot{S}i^2$:—more probable, $\dot{B}e^3\ddot{S}i^2+\ddot{\mathbf{A}}\mathbf{l}\ddot{S}i^2$, (Ramm.)

Chrysoberyl (394)$=\ddot{\mathbf{A}}\mathbf{l}^4\ddot{S}i+2\ddot{\mathbf{B}}e\ddot{\mathbf{A}}\mathbf{l}^4$.—Later, $\dot{B}e\ddot{\mathbf{A}}\mathbf{l}$, (Awdejew.)

Leucophane (235)$=\mathrm{Na}\mathbf{Fl}+\dot{C}a^3\ddot{S}i^2+\dot{B}e^3\ddot{S}i$, (Awdejew.)

Helvin (385)$=\mathrm{Mn}\dot{M}n+3(\dot{M}n, \dot{B}e, \dot{F}e)^2\ddot{S}i$, (Ramm., from Gmelin's analysis.

Family 6. Zirconia.

Zircon (417)$=\ddot{\mathbf{Z}}\mathrm{r}\ddot{S}i$.

Eudialyte (416)$=6(\dot{C}a, \dot{N}a)\ddot{S}i+\ddot{\mathbf{Z}}\mathrm{r}, \ddot{\mathbf{F}}e,\ddot{\mathbf{M}}\mathbf{n})^2\ddot{S}i^3$, (Ramm., from Stromeyer's Anal.)

Œrstedite (432)=two thirds titanic acid and zirconia, and one third $(\dot{C}a, \dot{M}g, \dot{F}e)^3\ddot{S}i^2+9\dot{\mathbf{H}}$.

Wöhlerite (433)$=\ddot{\mathbf{Z}}\mathrm{r}^3\ddot{\mathbf{T}}a+5(\dot{N}a\ddot{S}i+\dot{C}a^3\ddot{S}i,)$ (Scheerer.)

Family 7. Thoria.

Thorite (430)$=\dot{T}h^3\ddot{S}i+3\dot{\mathbf{H}}$, (? Berz.)

Family 8. Yttrium.

Xenotime (260)$=\dot{Y}^3\dddot{\mathbf{P}}$.

Gadolinite (431)$=\dot{Y}^3\ddot{S}i$ or $(\dot{Y}, \dot{C}e, \dot{F}e)^3\ddot{S}i$, (Berlin:) $(\dot{F}e,\dot{C}e)^6\ddot{S}i+4\dot{Y}^3\ddot{S}i$, (Berz.) The yttria in Gadolinite, and other species containing this earth,

has been found by Mosander to be a compound of yttria with oxyds of the two new metals Erbium and Terbium.

Fergusonite (435)=$(\dot{Y}, Ce)^6\dddot{\mathbf{Ta}}$.

Polymignite (433.) Formula undetermined.

Yttro-columbite (435)—Dark brown=$(\dot{Y}, \dot{C}a)^3\dddot{\mathbf{Ta}}$; the black=$(\dot{Y}, \dot{C}a, \dot{F}e)^3(\dddot{\mathbf{Ta}}, \dddot{W}$;) the yellow=$\dot{Y}^3(\dddot{\mathbf{Ta}}, \ddot{\mathbf{U}}$.)

Euxenite (436.)

Family 9. Cerium.

Flucerine (258)=$CeFl + \mathbf{Ce}\mathbf{Fl}^3$.

Basic Flucerine (259)=$\mathbf{Ce}\mathbf{Fl}^3 + 3\dot{\mathbf{C}}\mathbf{e}\dot{\mathbf{H}}$, (Berz.)

Carbonate of Cerium (259)=$\dot{C}e^3\ddot{C} + 3\dot{\mathbf{H}}$, (Ramm.)

Cerite (428)=$\dot{C}e^3\dddot{S}i + 3\dot{\mathbf{H}}$, (Berz.;) oxyd of lanthanum is here included with the cerium, (Mosander.)

Titaniferous Cerite (432.)

Yttro-cerite (259) a neutral fluate of lime, cerium and yttrium.

Allanite (429)=$(\dot{F}e + \dot{C}e)^3\dddot{S}i + (\dot{C}a^3 + 2\mathbf{\ddot{A}l})\dddot{S}i$, (Berz,)—$3\dot{R}^3\dddot{S}i + 2\mathbf{\ddot{R}}\dddot{S}i$, (Scheerer,) which is also Scheerer's general formula for Orthite. The oxyd of Lanthanum is here included with the oxyd of cerium.

Orthite (429)=$3(\dot{C}e, \dot{Y}, \dot{F}e, \dot{M}n)^3\dddot{S}i + 2(\mathbf{\ddot{A}l}, \mathbf{\ddot{F}e})\dddot{S}i$, (Scheerer.)

Pyrorthite (430)=$\dot{C}e^3\dddot{S}i + 3\mathbf{\ddot{A}l}\dddot{S}i$, with tersilicates of the oxyds of cerium, yttrium, iron, and manganese, (Berz.)

Pyrochlore (431)=$Na\mathbf{Fl} + (\dot{C}a, \dot{T}h, \dot{C}e)^2\dddot{\mathbf{Ta}}$, (Wöhler,)—$Na\mathbf{Fl} + 2\dot{C}a^4\dddot{T}a^3$, (G. Rose) According to A. A. Hayes of Roxbury, Pyrochlore is a columbate and titanate of lime, and some light-colored crystals of microlite, a nearly pure columbate of lime.

Monazite (424)=$\dot{R}^3\dddot{\mathbf{P}}$, (Berz.)

Æschynite (432.)

CLASS V. METALS AND METALLIC ORES.

ORDER I. METALS NOT OXYDIZABLE AT THE ORDINARY TEMPERATURE.

Family 1. Platinum.

Native Platina (458.)

Family 2. Iridium.

Iridosmine (459)=IrOs; a 2d, $IrOs^3$—another, $IrOs^4$;

Irite (456) $= Fe\dot{\mathbf{I}}r^{3} + Fe\ddot{O}s + 3Fe\dot{\mathbf{C}}r$, (Berz.) (Ir, Os, Fe) (**Ir**, **O**s, **C**r) (? ; Ramm.)

Family 3. PALLADIUM.

Native Palladium (459.)

Family 4. GOLD.

Native Gold (460.)

Auro-tellurite (466) $= AgTe + 3PbTe + 2Au^{2}Te^{3}$ (? Ramm.)

Graphic Tellurium (466) $= Ag\,Te + 3Au\,Te^{3}$, (Berz.) Later, $AgTe + 2AuTe^{3}$, (Ramm.)

Family 5. SILVER.

1. *Native.*

Native Silver (461.)

2. *Combined with Sulphur or other Metals.*

Vitreous Silver (488) $= \overset{I}{A}g$.

Flexible Silver Ore (491.)

Sternbergite (490) $= \overset{I}{A}g + 2\overset{III}{\mathbf{F}}e$, (Ramm.)

Stromeyerite (488) $= \overset{I}{\mathbf{C}}u + \overset{I}{A}g$.

Polybasite (489) $= (\overset{III}{\mathbf{S}}b, \overset{III}{\mathbf{A}}s)9(\overset{I}{A}g, \overset{I}{\mathbf{C}}u.)$

Brittle Silver Ore (489) $= \overset{I}{A}g^{6}\overset{III}{\mathbf{S}}b$, (Rose's Anal.)

Miargyrite (506) $= \overset{I}{A}g\overset{III}{\mathbf{S}}b$.

Dark Red Silver Ore (506) $= \overset{I}{A}g^{3}\overset{III}{\mathbf{S}}b$.

Light Red Silver Ore (507) $= \overset{I}{A}g^{3}\overset{III}{\mathbf{A}}s$.

Antimonial Silver (467) $+ Ag^{2}Sb$—another $Ag^{3}Sb$.

Xanthokon (491.)

Antimonial Sulphuret of Silver (490) $= (\overset{I}{A}g^{3}\overset{III}{\mathbf{S}}b + 2\,\overset{I}{P}b^{3}\overset{III}{\mathbf{S}}b) + (\overset{I}{A}g^{2}\overset{III}{\mathbf{S}}b + \overset{I}{P}b\,\overset{III}{\mathbf{S}}b)$, (Wöhler.) $(\overset{I}{P}b\,\overset{III}{\mathbf{S}}b + \overset{I}{P}b) + (2\overset{I}{P}b\,\overset{III}{\mathbf{S}}b + 3\overset{I}{P}b) + (2\overset{I}{A}g\,\overset{III}{\mathbf{S}}b + 3\overset{I}{A}g,)$ (Berz.) It is a doubtful compound.

Eucairite (487) $= Cu^{2}Se + AgSe$, (Berz.)

Selensilver (487) $= AgSe$.

Telluric Silver (488) $= AgTe$.

3. *Combined with Chlorine, Bromine or Iodine.*

Horn Silver (299) $= Ag\mathbf{Cl}$.

Bromic Silver (300.)

Iodic Silver (300) $= Ag\mathbf{I}$.

4. *Combined with Oxygen Acids.*

Carbonate of Silver (298)=$\dot{A}g\ddot{C}$.

ORDER II. METALS, OXYDIZABLE AT THE ORDINARY TEMPERATURE, BUT NOT ACIDIFIABLE WITH OXYGEN.

Family 1. MERCURY.

Native Mercury (462.)
Native Amalgam (463)=$AgHy^3$—another $AgHy^2$.
Arquerite (463)=Ag^6Hy. (Domeyko.)
Selenid of Mercury (502)=$HySe+4HyS$, or $Hy(S, Se,)$ (Ramm.)
Rionite (502)=$2Zn^2Se^3+HySe$ (?) (Berz.)
Cinnabar (507)=$\overset{|}{Hy}$.
Horn Quicksilver (300)=$Hy\mathbf{Cl}$.
Iodic Mercury (300.)

Family 2. LEAD.

1. *Native.*

Native Lead (463.)

2. *Combined with Sulphur or other Metals.*

Galena (496)=$\overset{|}{P}b$.
Clausthalite (497)=$PbSe$.
Cobaltic Lead Ore (497.)
Tellurid of Lead (499)=$PbTe$.
Foliated Tellurium (499)=$\overset{|}{P}b^9\overset{|||}{\mathbf{S}}b+\overset{|}{P}b^9\mathbf{Au}Te^6$, (Berz.)
Selenid of Lead and Copper (498)=$PbSe+CuSe$.
Selenid of Copper and Lead (498)=$2PbSe+CuSe$. Another, $4PbSe+CuSe$, (see p. 498, at bottom.) Frankenheim writes the general formula for the selenids of lead and copper, $(Pb, \mathbf{Cu})Se$.
Selenid of Mercury and Lead (499.)
Selenid of Lead and Cobalt (498)=$CoSe^2+6PbSe$, (Mech. mixture ?)

3. *Combined with Oxygen.*

Minium (285)=$Pb\dot{\mathbf{P}}b$, (Berz.)
Plumbic Ochre (285)=$\dot{P}b$.
Superoxyd of Lead, (Schwerbleierz) (286)=$\ddot{P}b$.

4. *Combined with Chlorine.*

Cotunnite (275)=$Pb\mathbf{Cl}$.
Cerasite (275)=$Pb\mathbf{Cl}+2\dot{P}b$.

5. *Combined with Oxygen Acids.*

Anglesite (277) = $\dot{Pb}\dddot{S}$.

Cupreous Anglesite (284) = $\dot{Pb}\dddot{S}+\dot{Cu}\mathbf{H}$.

Caledonite (284) = $\dot{Cu}\ddot{C}+2\dot{Pb}\ddot{C}+3\dot{Pb}\dddot{S}$, (v. Kobell.)

Dioxylite (276) = $\dot{Pb}\dddot{S}+\dot{Pb}\ddot{C}$.

Leadhillite (276) = $\dot{Pb}\dddot{S}+3\dot{Pb}\ddot{C}$.

White Lead Ore (274) = $\dot{Pb}\ddot{C}$.

Corneous Lead (275) = $Pb\mathbf{Cl}+\dot{Pb}\ddot{C}$, (Berz.)

Pyromorphite (278) }
Mimetene (279) } = $Pb\mathbf{Cl}+3\dot{Pb}^3(\dddot{\mathbf{P}}, \dddot{\mathbf{As}},)$ (Wöhler.)

Hedyphane (278) = $Pb\mathbf{Cl}+3(Pb, Ca)^3(\dddot{\mathbf{P}}, \dddot{\mathbf{As}},)$ (Kersten.)

Nussierite (279) = $Pb\mathbf{Cl}+5(Pb, Ca, Fe\ ?)^3(\mathbf{P}, \mathbf{As}.)$

Chromate of Lead (282) = $\dot{Pb}\dddot{Cr}$.

Melanochroite (283) = $\dot{Pb}^3\dddot{Cr}^2$.

Vauquelinite (283) = $\dot{Cu}^3\dddot{Cr}^2+2\dot{Pb}^3\dddot{Cr}^2$.

Selenate of Lead (280.)

Tungstate of Lead (282) = $\dot{Pb}\dddot{W}$.

Molybdate of Lead (286) = $\dot{Pb}\dddot{Mo}$. A basic Molybdate of Lead from Paramó-Rico, S. A., according to Boussingault = $\dot{Pb}^3\dddot{Mo}$.

Vanadinite (281) = $Pb\mathbf{Cl}Pb^2+\dot{Pb}^3\dddot{V}^2$, (variety from Zimapan; Berz.)

Plumbo-resinite (285) = $\dot{Pb}\ddot{\mathbf{Al}}^2+6\dot{\mathbf{H}}$—perhaps $\dot{Pb}^3\mathbf{P}+6\mathbf{Al}\mathbf{H}^3$, (Damour.)

Family 8. Copper.

1. *Native.*

Native Copper (464.)

2. *Combined with Sulphur or other Metals.*

Vitreous Copper Ore (486) = $\overset{|}{Cu}$.

Blue Copper (486) = $\overset{|}{Cu}$.

Variegated Copper Ore (480) = $\overset{|}{Cu}^2\overset{|}{Fe}$, (Berz.; specimens from Ross Island, Siberia, &c.) According to Plattner, the formula for the crystallized ore is $\overset{|}{Cu}^3\overset{|||}{Fe}$, giving the theoretical composition, Copper 55·74, iron 15·93, and sulphur 28·33; a variety from Eisleben gives $\overset{|}{Cu}^4\overset{|}{Fe}$; another from Sangerhausen, $\overset{|}{Cu}^9\overset{|}{Fe}^2$; another from Siberia, $\overset{|}{Cu}^3\overset{|||}{Fe}$. Bodemann gives the last as the formula for the ore from Bristol, Ct.

Copper Pyrites (481) = $\overset{|}{Cu}\overset{|||}{Fe}$, (1st analysis, see Desc. of Species;) $\overset{|}{Cu}^3\overset{|||}{Fe}$, (2d analysis;) $\overset{|}{Cu}^5\overset{|||}{Fe}$, (last 3 analyses.)

73

Bournonite (484)=$\overset{I}{\mathbf{C}}u^3\overset{III}{\mathbf{S}}b+2\overset{I}{P}b^3\overset{III}{\mathbf{S}}b$.

Tennantite (485)=$(\overset{I}{F}e, \overset{I}{\mathbf{C}}u)^4\overset{III}{\mathbf{A}}s+2\overset{I}{\mathbf{C}}u^4\overset{III}{\mathbf{A}}s$. $(\overset{I}{\mathbf{C}}u, \overset{I}{F}e)^4\overset{III}{\mathbf{A}}s$, (Frankenheim,) which is analogous to that of Gray Copper Ore, given below.

Antimonial Copper (487)=$\overset{I}{\mathbf{C}}u+\overset{III}{\mathbf{S}}b$.

Gray Copper Ore (483) (Fahlerz)=$(\overset{I}{F}e, \overset{I}{Z}n)^4(\overset{III}{\mathbf{S}}b, \overset{III}{\mathbf{A}}s)+2\overset{I}{\mathbf{C}}u^4(\overset{III}{\mathbf{S}}b, \overset{III}{\mathbf{A}}s,)$ (H. Rose.) The Silver fahlerz has the formula $(\overset{I}{F}e, \overset{I}{Z}n)^4\overset{III}{\mathbf{S}}b+2(\overset{I}{\mathbf{C}}u, \overset{I}{A}g)^4\overset{III}{\mathbf{S}}b$, (H. Rose:) according to Frankenheim, who makes $\overset{I}{\mathbf{C}}u$ and $\overset{I}{F}e$ isomorphous, the formula is $(\overset{I}{\mathbf{C}}u, \overset{I}{A}g, \overset{I}{F}e, \overset{I}{Z}n)^4(\overset{III}{\mathbf{S}}b, \overset{III}{\mathbf{A}}s.)$

Selenid of Copper (487)=Cu^2Se, (Berz.)

3. *Combined with Oxygen.*

Red Copper Ore (425)=$\mathbf{C}u$.

Black Copper (426)=Cu.

4. *Combined with Chlorine.*

Atacamite (293)=$CuCl+3\dot{C}u+3\dot{\mathbf{H}}$, (Klaproth and Davy; or $6\dot{\mathbf{H}}$, according to Berthier's analysis.)

5. *Combined with Oxygen Acids.*

Blue Vitriol (226)=$\dot{C}u\dddot{S}+5\dot{\mathbf{H}}$. Berthier has analyzed an ore from Mexico, giving the formula $\dot{C}u^4\dddot{S}+4\dot{\mathbf{H}}$, which is near Brochantite.

Brochantite (295)=$\dot{C}u^3\dddot{S}+3\dot{\mathbf{H}}$, (Magnus's analysis.)

Green Malachite (286)=$\dot{C}u^2\ddot{C}+\dot{\mathbf{H}}$.

Myssorin (287)=$\dot{C}u^2\ddot{C}$.

Azurite (Blue Malachite) (286)=$2\dot{C}u\ddot{C}+\dot{C}u\dot{\mathbf{H}}$, (Berz.)

Aurichalcite (287)=$2(\dot{C}u, \dot{Z}n)\ddot{C}+3(\dot{C}u, \dot{Z}n)\dot{\mathbf{H}}$, or, $2(\dot{C}u, \dot{Z}n)^2\ddot{C}+(\dot{C}u, \dot{Z}n)\dot{\mathbf{H}}^3$, (Böttger's analysis.)

Libethenite (292)=$\dot{C}u^4\dddot{\mathbf{P}}+2\dot{\mathbf{H}}$, (Berz.) $\dot{C}u^4\dddot{\mathbf{P}}+\dot{\mathbf{H}}$, (G. Rose, who makes Libethenite and Olivenite isomorphous.)

Kuhn's Phosphate of Copper (292)=$\dot{C}u^6\dddot{\mathbf{P}}+3\dot{\mathbf{H}}$.

Thrombolite (532)=$\dot{C}u^3\dddot{\mathbf{P}}^2+6\dot{\mathbf{H}}$ (?).

Pseudomalachite (291)=$\dot{C}u^5\dddot{\mathbf{P}}+5\dot{\mathbf{H}}$, (Berz.)

Olivenite (292)=$\dot{C}u^4(\dddot{\mathbf{A}}s, \dddot{\mathbf{P}})+\dot{\mathbf{H}}$, (G. Rose.)

Aphanesite (290.)

Euchroite (289)=$\dot{C}u^4\dddot{\mathbf{A}}s+8\dot{\mathbf{H}}$, (Berz.) $\dot{C}u^4\dddot{\mathbf{A}}s+7\dot{\mathbf{H}}$, (v. Kobell.)

Erinite (290)=$\dot{C}u^5\dddot{\mathbf{A}}s+2\dot{\mathbf{H}}$.

Liroconite (291)=$\dot{C}u^{10}\dddot{\mathbf{A}}s+30\dot{\mathbf{H}}$ (?) (Chenevix's analysis.)

Copper Mica (293)=$\dot{Cu}^8\dddot{\mathbf{As}}+12\dot{\mathbf{H}}$.

Condurrite (294)=$\dot{Cu}^6\dddot{\mathbf{As}}+4\dot{\mathbf{H}}$, (v. Kobell.)

Copper Froth (294)=$\dot{Cu}^5\dddot{\mathbf{As}}+10\dot{\mathbf{H}}$, with $\dot{Ca}\ddot{C}$.

Volborthite, *Vanadate of Copper* (295.)

Dioptase (289)=$\dot{Cu}^3\dddot{Si}^2+3\dot{\mathbf{H}}$, (Hess's analysis.)

Chrysocolla (288)=$\dot{Cu}^3\dddot{Si}^2+6\dot{\mathbf{H}}$, (v. Kobell; from Siberia; also from Somerville, N. J.)

Family 9. Uranium.

1. *Combined with Oxygen, or Metallic Acids.*

Pitchblende (439)=U. From Joachimstahl, $\dot{U}\,\mathbf{U}$, (Ramm.)
Uranotantalite (438.)

2. *Combined with Unmetallic Oxygen Acids.*

Johannite (227.)
Uranite (297)=$\dot{Ca}^3\dddot{\mathbf{P}}+2\mathbf{U}^3\dddot{\mathbf{P}}+24\dot{\mathbf{H}}$.
Chalcolite (297)=$\dot{Cu}^3\dddot{P}+2\mathbf{U}^3\dddot{\mathbf{P}}+24\dot{\mathbf{H}}$.
Uranic Ochre (296.)

Family 10. Nickel.

1. *Combined with Sulphur, or with other Metals.*

Capillary Pyrites (471)=$\overset{\prime}{Ni}$.

Sulphuret of Iron and Nickel (Eisennickelkies) (472) = $\overset{\prime}{Ni}+2\overset{\prime}{Fe}$, (Scheerer.)

Copper Nickel (470)=NiAs, or Ni(As, Sb.)
White Nickel (470)=$NiAs^2$, or (Ni, Co, Fe)As^2.
Placodine (471)=$Ni^4\mathbf{As}$, (Plattner.)
Nickel Glance (471)=NiS^2+NiAs^2, (Berz.) Ni(As, S)^2, (Frank.)
Antimonial Nickel (469)=NiSb.
Nickel Stibine (469)=$NiS^2+Ni(Sb, As)^2$.
Bismuth Nickel (472)=$\overset{\prime}{Bi}+4\overset{\prime\prime\prime}{\mathbf{Ni}}$, (v. Kobell)—$\overset{\prime}{Ni}\overset{\prime\prime}{\mathbf{Bi}}+6\overset{\prime}{Ni}\overset{\prime\prime\prime}{\mathbf{Ni}}$, (Ramm.)

2. *Combined with Oxygen Acids.*

Nickel Green (296)=$\dot{Ni}^3\dddot{\mathbf{As}}+8\dot{\mathbf{H}}$, (Kersten, who makes it isomorphous with Vivianite.)

Family 11. Cobalt.

1. *Combined with Sulphur or Arsenic.*

Cobalt Pyrites (474)=$\overset{\prime\prime\prime}{\mathbf{Co}}$; more probable $\overset{\prime}{Co}\overset{\prime\prime\prime}{\mathbf{Co}}$, (Frankenheim.)

Cobaltine (473) $=CoS^2+CoAs^2$, (Berz.; Stromeyer's analysis.)

Smaltine (472) $=CoAs^2$; or $(Co, Fe, Ni)As^2$; another from Skutterud $=CoAs^3$.

2. *Combined with Acids.*

Cobalt Vitriol (227) $=\dot{C}o^3\dddot{S}+8\dot{\mathbf{H}}$, (Berz., from Kopp's Anal.)

Cobalt Bloom (273) $=\dot{C}o^3\overset{.....}{\mathbf{As}}+8\dot{\mathbf{H}}$, (Kersten, who makes it isomorphous with Vivianite and Nickel Green.)

Roselite (273; also, see Addenda.)

Arsenite of Cobalt (274.)

Family 12. Iron.

1. *Native or Alloyed.*

Native Iron (457.)

Meteoric Iron (457.)

2. *Combined with Sulphur or Arsenic.*

Iron Pyrites (478) }
White Iron Pyrites (477) } $=\overset{\text{II}}{Fe}$.

Magnetic Pyrites (476) $=\overset{\text{I}}{Fe}{}^6\overset{\text{II}}{Fe}$, or $\overset{\text{I}}{Fe}{}^5\overset{\text{III}}{\mathbf{Fe}}$. Schaffgotsch makes the following different compounds: 1, $\overset{\text{I}}{Fe}\overset{\text{III}}{\mathbf{Fe}}$, (from Barèges;) 2, $\overset{\text{I}}{Fe}{}^5\overset{\text{III}}{\mathbf{Fe}}$, (common variety;) 3, $\overset{\text{I}}{Fe}{}^9\overset{\text{III}}{\mathbf{Fe}}$, from Bodenmais. Frankenheim considers magnetic pyrites, capillary pyrites and Greenockite isomorphous, and hence gives the formula $\overset{\text{I}}{Fe}$, the varieties arising from mixture with common pyrites.

Mispickel (475) $=Fe(S^2, As^2)$, or $(Fe, Co)(S^2, As^2)$, (Ramm.)

Leucopyrite (474) $=FeAs^2$, (from Fossum.) $(Fe, Ni, Co)As^2$, (from Schladming.)

3. *Combined with Oxygen.*

Magnetic Iron Ore (452) $=\dot{F}e\dddot{\mathbf{Fe}}$.

Specular Iron (450) $=\dddot{\mathbf{Fe}}$.

Brown Iron Ore (449) $=\dddot{\mathbf{Fe}}{}^2\dot{\mathbf{H}}{}^3$.

Göthite (450) $=\dddot{\mathbf{Fe}}\dot{\mathbf{H}}$.

Franklinite (453) $=(\dot{Mn}, \dot{Fe}, \dot{Zn})(\dddot{\mathbf{Fe}}, \dddot{\mathbf{Mn}})$.

4. *Combined with the Insoluble Metallic Acids.*

Ilmenite (454) $=\dddot{\mathbf{Fe}}+6\dot{F}e\ddot{T}i$, (v. Kobell.) The Arendal titanic iron (Hystatite) $\dddot{\mathbf{Fe}}+\dot{F}e\ddot{T}i$; Egersund Titanic iron (Menaccanite) $=\dddot{\mathbf{Fe}}+3\dot{F}e\ddot{T}i$;

Aschaffenburg $= 3\ddot{\mathbf{F}}e + \dot{F}e\ddot{T}i$; from Gastein, (Kibdelophane) $= \dot{F}e^2\ddot{T}i^3$; (v. Kobell;) From Uddewalla $= \dot{F}e\ddot{T}i + 2\ddot{\mathbf{F}}e$, (Plantamour.)

Warwickite (455.)

Chromic iron (445) $= \dot{F}e\ddot{C}r$, or $(\dot{F}e, \dot{M}g)(\ddot{C}r, \ddot{A}l.)$

Wolfram (439) $= (\dot{F}e, \dot{M}n)\dddot{W}$. The following compounds are given by Schaffgotsch: from Monte Video and Ehrenfriedersdorf, $\dot{M}n\dddot{W} + 4\dot{F}e\dddot{W}$; from Chanteloupe and Cumberland, $\dot{M}n\dddot{W} + 3\dot{F}e\dddot{W}$; from Zinnwald, $3\dot{M}n\dddot{W} + 2\dot{F}e\dddot{W}$.

Columbite (436) (Bodenmais, Haddam, &c.) $= \dot{F}e^3\dot{\mathbf{T}}a^2 + \dot{M}n^3\dot{\mathbf{T}}a^2$, (Berz.)

Ferrotantalite (438.) (Kimito Tantalite) $= \dot{F}e\dot{\mathbf{T}}a + \dot{M}n\dot{\mathbf{T}}a$; Finbo Tantalite $= (\dot{F}e, \dot{M}n)(\dot{\mathbf{T}}a, \ddot{S}n;)$ Broddbo Tantalite $= (\dot{F}e, \dot{M}n)(\dot{\mathbf{T}}a, \ddot{S}n, \dddot{W}.)$ The general formula may be $(\dot{F}e, \dot{M}n)(\dot{T}a, \ddot{S}n, \dddot{W},)$

5. *Combined with Silica.*

Yenite (448) $= 3(\dot{C}a, \dot{F}e)^3\dddot{S}i + 2\ddot{\mathbf{F}}e\dddot{S}i$, (Ramm.)

Iron-chrysolite $= \dot{F}e^3\dddot{S}i$.

Knebelite (527) $= \dot{F}e^3\dddot{S}i + \dot{M}n^3\dddot{S}i$.

Hisingerite (446) $= \dot{F}e\dddot{S}i + \ddot{\mathbf{F}}e\dddot{S}i + 6\dot{H}$. (From Riddarhyttan; Hisinger.)

Nontronite (303) $= \ddot{\mathbf{F}}e\dddot{S}i^2 + 6\dot{H}$, (?)

Pinguite (304) $= (\ddot{\mathbf{F}}e, \ddot{A}l, \dot{F}e^3)\dddot{S}i^3 + 6\dot{H}$, (Berz.)

Anthosiderite (446) $= \ddot{\mathbf{F}}e\dddot{S}i^3 + \dot{H}$.

Sideroschisolite (447) $= \dot{F}e^6\dddot{S}i + 2\dot{H}$, (v. Kobell,) $\dot{F}e^6\dddot{S}i + 3\dot{H}$, (Berz.)

Cronstedtite (446) $= (\dot{F}e, \dot{M}n, \dot{M}g)^3\dddot{S}i + \ddot{\mathbf{F}}e\dot{H}^3$, (v. Kobell.)

Chloropal (447.)

Chamoisite (447) $= 2\dot{F}e^3\dddot{S}i + \dot{F}e^6\ddot{A}l + 12\dot{H}$ (?) (Ramm.)

Crocidolite (445) $= (\dot{N}a, \dot{M}g)^3\dddot{S}i^4 + 3\dot{F}e^3\dddot{S}i^2 + x\dot{H}$, (Berz.; Stromeyer's analysis.)

Pyrosmalite (272) $= [\mathbf{F}eCl^3 + \ddot{\mathbf{F}}e\dot{H}^6] + [4(\dot{F}e^3\dddot{S}i^2 + \dot{M}n^3\dddot{S}i^2.)]$

Wehrlite (449.)

Chloritoid (523) $= \dot{F}e^3\dddot{S}i^4 + 3\dot{F}e\ddot{A}l^2$, (Berz.) $(\dot{F}e, \dot{M}g)\dddot{S}i + \ddot{A}l^2\dddot{S}i + 9\dot{H}$, (Bonsdorff.)

6. *Combined with Oxygen Acids.*

Copperas (224) $= \dot{F}e\dddot{S} + 6\dot{H}$, (or $7\dot{H}$.) The vitriol ochre of Fahlun $= \ddot{\mathbf{F}}e^2\dddot{S} + 6\dot{H}$, (Berz.)

Botryogen (227) $= \dot{F}e^3\dddot{S}^2 + 3\ddot{\mathbf{F}}e\dddot{S}^2 + 36\dot{H}$, (Berz.)

Coquimbite (225)=$\ddot{\mathbf{F}}e\ddot{S}^3+9\dot{\mathbf{H}}$.

Yellow Copperas (225)=$\ddot{\mathbf{F}}e^2\ddot{S}^5+18\dot{\mathbf{H}}$.

Potash Copperas (226)=$4\ddot{\mathbf{F}}e\ddot{S}+\dot{K}\ddot{S}+9\dot{\mathbf{H}}$.

Soda Copperas (226)=$4\ddot{\mathbf{F}}e\ddot{S}+\dot{N}a\ddot{S}+9\dot{\mathbf{H}}$.

Fibro-ferrite (226)=$\ddot{\mathbf{F}}e^2\ddot{S}^3+18\dot{\mathbf{H}}$, (Prideaux.)

Voltaite (533)=$3\dot{R}\ddot{S}+2\ddot{\mathbf{R}}\ddot{S}^3+12\dot{\mathbf{H}}$, in which $\dot{R}=\dot{F}e$, $\dot{K}$, $\dot{N}a$, and $\ddot{\mathbf{R}}=\ddot{\mathbf{F}}e$, $\ddot{\mathbf{A}}l$, (Rammelsberg, from Abich's analysis of artificial Voltaite.)

Spathic iron (251)=$\dot{F}e\ddot{C}$.

Mesitine Spar (252)=$\dot{M}g\ddot{C}+\dot{F}e\ddot{C}$.

Oligon Spar (252)=$2\dot{M}n\ddot{C}+3\dot{F}e\ddot{C}$.

Vivianite (270)=$\dot{F}e^3\dddot{\mathbf{P}}+8\dot{\mathbf{H}}$, ($6\dot{\mathbf{H}}$, in some?)

Anglarite (271)=$\dot{F}e^4\dddot{\mathbf{P}}+4\dot{\mathbf{H}}$, (Berthier.)

Beraunite (522.)

Triphyline (269)=$(\dot{F}e, \dot{M}n, \dot{L}i)^3\dddot{\mathbf{P}}$.

Green Iron Ore (271)=$2\ddot{\mathbf{F}}e^2\dddot{\mathbf{P}}+5\dot{\mathbf{H}}$.

Delvauxene (524)=$\ddot{\mathbf{F}}e^2\dddot{\mathbf{P}}+24\dot{\mathbf{H}}$, (Ramm.)

Cacoxene (233)=$(\ddot{\mathbf{F}}e, \ddot{\mathbf{A}}l)^5\dddot{\mathbf{P}}^2+20\dot{\mathbf{H}}$, (v. Kobell.) Isomorphous with Wavellite.

Carphosiderite (272.)

Phosphate of Iron and Manganese (267.)

Cube Ore (268)=$\dot{F}e^3\dddot{\mathbf{A}}s+\ddot{\mathbf{F}}e^3\dddot{\mathbf{A}}s^2+18\dot{\mathbf{H}}$.

Scorodite (269)=$\dot{F}e^2\dddot{\mathbf{A}}s+2\ddot{\mathbf{F}}e\dddot{\mathbf{A}}s+12\dot{\mathbf{H}}$, (Berz.)

Iron Sinter (268)=$\dot{F}e^2\dddot{\mathbf{A}}s+12\dot{\mathbf{H}}$:—another $(\ddot{\mathbf{F}}e^3\dddot{\mathbf{A}}s^2+15\dot{\mathbf{H}})+(\ddot{\mathbf{F}}e\ddot{S}^2+15\dot{\mathbf{H}}$.) (Stromeyer's analysis.)

Oxalate of Iron (230)=$2\dot{F}e\ddot{\mathbf{C}}+3\dot{\mathbf{H}}$.

Family 13. Manganese.

1. *Combined with Sulphur or Arsenic.*

Manganblende (503)=$\acute{M}n$.

Arsenid of Manganese (474)=MnAs.

2. *Combined with Oxygen.*

Pyrolusite (442)=$\ddot{M}n$.

Earthy Cobalt (443)=$(\dot{C}o, \dot{C}u)\ddot{M}n^2+4\dot{\mathbf{H}}$, from Camsdorf, near Saalfield, (Ramm).

Braunite, (440)=$\dddot{\mathbf{M}}n$.

Hausmannite (440)=$\dot{M}n\dddot{\mathbf{M}}n$.

Manganite (441) = $\ddot{\mathbf{M}}\mathbf{n}\dot{\mathbf{H}}$.

Wad (444) = $\ddot{\mathbf{M}}\mathbf{n}\mathbf{H} + 2\ddot{\mathbf{F}}\mathbf{e}\mathbf{H}$, with some $\dot{B}a\ddot{\mathbf{M}}n + \dot{\mathbf{H}}$, (some varieties, according to Berzelius ;) $\ddot{M}n + \dot{\mathbf{H}}$, (Groroilite.)

Psilomelane (441) = $\dot{R}\ddot{M}n^2 + \dot{\mathbf{H}}$, (Ramm.)

Varvacite (444) = $\ddot{\mathbf{M}}\mathbf{n}\dot{\mathbf{H}} + 2\ddot{M}n$ (?)—probably a mechanical mixture, (Berz.)

Newkirkite (444.)

Cupreous Manganese (441) = $\dot{C}u\dddot{\mathbf{M}}n^3 + 6\ddot{\mathbf{M}}\mathbf{n}\dot{\mathbf{H}}^3$, (Berz.) $\dot{C}u\ddot{\mathbf{M}}n\dot{\mathbf{H}}^{0} + 3\ddot{\mathbf{M}}n^2\dot{\mathbf{H}}^3$, (v. Kobell.) $\dot{R}\ddot{M}n^2 + 2\dot{\mathbf{H}}$, (Ramm. ; similar to Psilomelane.)

3. *Combined with Titanic Acid.*

Greenovite (423.)

4. *Combined with Silica.*

Manganese Spar (362) = $Mn^3\dddot{S}i^2$.

Heteroclin (443.)

Troostite (363) = $\dot{F}e^3\ddot{S}i^2 + 3\dot{M}n^3\ddot{S}i$.

Bustamite (363) = $\dot{C}a^3\ddot{S}i^2 + 2\dot{M}n^3\dddot{S}i^2$.

Hydrous silicate of Manganese—Black Manganese from Klapperud, according to Klaproth's analysis, $\dot{M}n^3\ddot{S}i + 3\dot{\mathbf{H}}$, (Berz.)

Helvin—see under Glucina.

5. *Combined with Soluble Acids.*

Triplite (266) = $\dot{F}e^4\dddot{\mathbf{P}} + \dot{M}n^4\dddot{\mathbf{P}}$.

Heterozite (267) = $2\dot{F}e^5\dddot{\mathbf{P}}^2 + \dot{M}n^5\dddot{\mathbf{P}}^2 + 5\dot{\mathbf{H}}$.

Huraulite (267) = $3\dot{M}n^5\dddot{\mathbf{P}}^2 + \dot{F}e^5\dddot{\mathbf{P}}^2 + 30\dot{\mathbf{H}}$, (Dufrenoy's Anal.)

Diallogite (253) = $\dot{M}n\ddot{C}$.

Family 14. ZINC.

1. *Combined with Sulphur or Oxygen.*

Blende (503) = $\acute{Z}n$; Marmatite = $\acute{F}e + 3\acute{Z}n$.

Veltzite (504) = $4\acute{Z}n + \dot{Z}n$.

Red Zinc Ore (426) = $\dot{Z}n$.

2. *Combined with Acids.*

White Vitriol (226) = $\dot{Z}n\dddot{S} + 7\dot{\mathbf{H}}$.

Calamine (263) = $\dot{Z}n\ddot{C}$.

Zinc Bloom (264) = $(\dot{Z}n\ddot{C} + \dot{\mathbf{H}}) + 2\dot{Z}n\dot{\mathbf{H}}$, (Smithson's Anal.)

Willemite (265) = Zn^3Si. The silicate from Mancino gives the formula $ZnSi$.

Electric Calamine (265) = $2Zn^3Si + 3\mathbf{H}$, (Berz.).

Hopeite (266.)

Family 15. Cadmium

Greenockite (505) = $\overset{\prime}{C}d$

Family 16. Bismuth

1. Native.

Native Bismuth (463.)

2. Combined with Sulphur, or with other Metals.

Sulphuret of Bismuth, or Bismuth Glance (500) = $\mathbf{Bi}$, (Ramm.)

Acicular Bismuth (501) = $\mathbf{Cu}^3\mathbf{Bi} + 2Pb^3\mathbf{Bi}$, (Ramm.)

Tetradymite (501) = $Bi^2S^3 + 2Bi^2Te^3$, (Ramm.)

Cupreous Bismuth (501) = $\mathbf{Cu}Bi$, (Berz.)

3. Combined with Oxygen, or Oxygen Acids.

Bismutite (262)—Bismuth Ochre = $\mathbf{Bi}$, (Ramm.)

Bismuth Blende (263) = $2\mathbf{Bi}^2Si^5 + \mathbf{Bi}^2\mathbf{P}$, (Ramm.) $\mathbf{Bi}^2Si^3$, with some $Fe\mathbf{P}$ and $\mathbf{Fe}Fl^3$, (Frankenheim.)

ORDER III. ACIDIFIABLE METALS.

Family 17. Tin

Tin Pyrites (483) = $(\overset{\prime}{F}e, \overset{\prime}{Z}n)^2Sn + \overset{\prime}{C}u^2Sn$, or $\overset{\prime}{S}n^2\overset{\prime\prime}{F}e + \overset{\prime}{C}u^2\overset{\prime\prime}{F}e$

Tin Ore (427) = Sn

Family 18. Titanium

Anatase (423.)

Rutile (420) = Ti

Sphene (421) = $CaTi^3 + 2CaSi$, (v. Kobell.) $Ca^3Si + Ti^3Si$, late by H. Rose.

Brookite (424.)

Perovskite (424.)

Family 19. Molybdenum

Molybdenite (500) = $\overset{\prime\prime}{M}o$.

Molybdic Ochre (528) = Mo

Family 20. Tungsten

Tungstic Acid (261)=$\dddot{W}$.

Tungstate of Lime (260)=$Ca\dddot{W}$.

Family 21. Chromium.

Chromic Ochre=($\mathbf{Al}$, $\mathbf{Cr}$, $\mathbf{Fe}$)$\dddot{Si}^2$, (?—Ramm.)

Family 22. Tellurium.

Native Tellurium (465.)

Family 23. Antimony.

1. *Native.*

Native Antimony (466.)

2. *Combined with Sulphur or Arsenic.*

Gray Antimony (491)=$\overset{III}{\mathbf{S}b}$.

Berthierite (492)=$\overset{I}{F}e^3\overset{III}{\mathbf{S}b}^2$, (from Chazelles,) $\overset{I}{F}e^3\overset{III}{\mathbf{S}b}^4$, (from Martouret,) $\overset{I}{F}e\overset{III}{\mathbf{S}b}$, (from Anglar and Braunsdorf, Berthier.)

Geocronite (493)=$\overset{I}{P}b^5(\overset{III}{\mathbf{S}b}, \overset{III}{\mathbf{A}s},)$ or better $\overset{I}{P}b(\overset{III}{\mathbf{S}b}, \overset{III}{\mathbf{A}s})+4\overset{I}{P}b$, (Svanberg.)

Kilbrickenite (493)=$\overset{I}{P}b^6\overset{III}{\mathbf{S}b}$, or $\overset{I}{P}b\overset{III}{\mathbf{S}b}+5\overset{I}{P}b$.

Zinkenite (493)=$\overset{I}{P}b\overset{III}{\mathbf{S}b}$

Plagionite (494)=$\overset{I}{P}b\ \overset{III}{\mathbf{S}b}^{3}$, or $3\overset{I}{P}b\overset{III}{\mathbf{S}b}+\overset{I}{P}b$, (H. Rose.)

Jamesonite (494)=$\overset{I}{P}b^3\overset{III}{\mathbf{S}b}^2$, or $2\overset{I}{P}b\overset{III}{\mathbf{S}b}+\overset{I}{P}b$, (H. Rose.)

Feather Ore (495)=$\overset{I}{P}b^2\overset{III}{\mathbf{S}b}$, or $\overset{I}{P}b\overset{III}{\mathbf{S}b}+\overset{I}{P}b$, (H. Rose.)

Boulangerite (495)=$\overset{I}{P}b\ \overset{III}{\mathbf{S}b}$, or $\overset{I}{P}b\overset{III}{\mathbf{S}b}+2\overset{I}{P}b$.

Kobellite (495)=$\overset{I}{F}e^3\overset{III}{\mathbf{S}b}^2+\overset{I}{P}b^3\overset{III}{\mathbf{B}i}$, (Setterburg's analysis.)

Arsenical Antimony, (495)=$SbAs^3$, or $\mathbf{SbAs}^3$, (Ramm.)

3. *Combined with Oxygen.*

White Antimony (261)=$\dddot{\mathbf{S}b}$.

Antimonous Acid (262)=$\mathbf{S}b$.

Antimonic Acid (262)=$\mathbf{S}b$.

Antimony Ochre=$\mathbf{S}b+x\dot{\mathbf{H}}$.

4. *Combined with Sulphur and Oxygen.*

Red Antimony (505)=$\mathbf{S}b\overset{III}{\mathbf{S}b}^2$

5 *Combined with Bases*

Romeine (Antimonate of Lime) (262)$=Ca^4 \dot{S}b^3$

Family 24 ARSENIC

Native Arsenic (167)

Arsenous Acid, (214)$=\mathbf{As}$

Realgar (508)$=\overset{\text{III}}{\mathbf{As}}$

Orpiment (509)$=\overset{\text{III}}{\mathbf{As}}$.

CLASS VI. SULPHUR

Native Sulphur (510.)

CLASS VII. RESINS AND COALS

Amber (512)
Settling stones Resin C^2H^3(?) Johnston
Middletonite (513)$=C^{20}H^{20}+H^2O$, Johnston
Fossil Copal (513)$=C^{40}H^{64}O$
Scheererite (518)$=CH^4$
Hartite (514)$=C^6H^{10}$—Fichtelite$=C^4H^6$—Konlite$=C^2H^2$
Ixolyte (514)
Hatchetine (514)
Ozocerite (515)$=CH^2$
Mineral Caoutchouc (515.) Equal number of atoms of Carbon and Hydrogen
Retinite (516)$=C^{12}H^{18}O$
Guyaquillite (516)$=C^{20}H^{26}O^3$, Johnston
Bitumen (516)
Idrialin (517)$=C^3H^2$.
Bituminous Coal (518.)
Anthracite (519.)
Graphite (519)

EXPLANATORY REMARKS ON CHEMICAL FORMULAS.

THE mode of deducing chemical formulas may be illustrated by two or three examples, taken from Rammelsberg

1 We have an analysis of Red Silver Ore as follows

Silver 58.949, antimony 22.846, and sulphur 16.609 per cent

It is desired to ascertain the relative number of atoms of each element in the compound. *Divide the per centage of each element by the atomic weight of the same* as, 58,949 by 1351·61, the atomic weight of silver, (taken from tables to be found in treatises on Chemistry) This process gives the relation,

0.013 0.028 0.082,

and *dividing each by the smallest*, to simplify it, it becomes

$1\frac{1}{2}$ 1 3, or, doubling each, 3 2 6,

which is therefore the number of atoms of each, silver, antimony, and sulphur. The formula $3Ag+2Sb+6S$, or $Ag^3Sb^2S^6$, expresses this relation

2 An analysis of Feldspar gives in 100 parts,

Silica 61.20, alumina 18.40, potash 16.95

From tables given in works on Chemistry,* we find that

61.20 of silica contains	33.35 of oxygen,		or dividing each by the smallest	12
18.40 of alumina "	8.59	"		3
16.95 of potash "	2.87	"		1

Now, each atom of silica contains 3 atoms of oxygen, there are therefore in the above, 4 atoms of silica, and for a similar reason, 1 atom of alumina and 1 of potash

The next step is to determine how these constituents are combined, how much of the silica with the potash, and how much with the alumina This requires experience Reference must be had to the possibility or probability of certain compounds, which Chemistry alone can teach but we may generally be guided by the principle, that the number of atoms of oxygen in each acid and base is some simple multiple, the one of the other If in the above compound, 1 of silica be united with 1 of potash, the ratio alluded to is 1 to 3, and if the alumina be combined with the remaining 3 atoms of silica, the same ratio holds This is their true mode of combi-

* Especially the admirable tables of BERZELIUS, appended to his *Théorie des proportions Chimiques, &c*, 8vo pp 476 Paris, 1835 Very valuable tables are also given in the recent work on Chemical Analysis, by Barreswill and Sobrero (*Appendice a tous les Traites d Analyse chimique recueil des observations publiées depuis dix ans sur l'Analyse qualitative et quantitative, par* C BARRESWILL et A SOBRERO *Paris, chez Fortin, Masson et Cie. Libraires, Avril,* 1843, 8vo, pp 547)

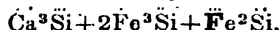
nation, and is expressed in the following formula, in which the dots indicate the atoms of oxygen:



$$\dot{K}\dddot{Si}+\dddot{Al}\dddot{Si}^{3}.$$

The index ^{3} expresses the number of atoms of silica; had the 3 been written before the $\dddot{Al}\dddot{Si}$ (thus, $3\dddot{Al}\dddot{Si}$) it would have meant 3 atoms of the compound $\dddot{Al}\dddot{Si}$.

3. In the same manner we find that Yenite contains 3 atoms of lime ($3\dot{C}a$,) 6 of protoxyd of iron ($6\dot{F}e$,) 2 of peroxyd of iron ($2\dddot{\mathbf{F}}$,) and 4 of silica ($4\dddot{Si}$.) Apportioning the silica to the several bases, 1 atom to the $3\dot{C}a$, 2 to the $6\dot{F}e$, and 1 to the $2\dddot{\mathbf{F}}e$, it gives the formula,



$$\dot{C}a^{3}\dddot{Si}+2\dot{F}e^{3}\dddot{Si}+\dddot{\mathbf{F}}e^{2}\dddot{Si},$$

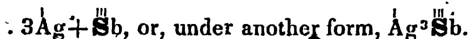
in which the simple ratio between the oxygen of the base and the oxygen of the silica is well illustrated. But lime and protoxyd of iron are isomorphous, and are therefore often linked together in the formula, as one may replace the other. Adding them gives 3 atoms of the two, to 3 of silica; the whole formula then becomes



$$3(\dot{C}a^{3}, \dot{F}e^{3})\dddot{Si}+\dddot{\mathbf{F}}e^{2}\dddot{Si}, \text{ or otherwise written, } 3(\dot{C}a, \dot{F}e)^{3}\dddot{Si}+\dddot{\mathbf{F}}e^{2}\dddot{Si}.$$

This formula might also be written $3\dot{R}^{3}\dddot{Si}+\dddot{\mathbf{F}}e^{2}\dddot{Si}$, $\dot{R}$ being used as a general expression for the different isomorphous bases included within the brackets. This mode of stating the formula in general terms, is often employed, and many examples of it occur in the preceding Table.

4. In the *first* example above, the sulphur is actually combined both with the silver and the antimony, and the mineral is a compound of sulphuret of antimony and sulphuret of silver, the former acting the part of an acid. The sulphuret of antimony known to act this part in such compounds, contains 3 atoms of sulphur: this leaves 3 atoms of sulphur for the 3 atoms of silver. The formula is therefore (using the mark ($^{\prime}$) for an atom of sulphur)



$$3\overset{\prime}{A}g+\overset{\prime\prime\prime}{\mathbf{S}}b, \text{ or, under another form, } \overset{\prime}{A}g^{3}\overset{\prime\prime\prime}{\mathbf{S}}b.$$

These few examples may suffice to illustrate the use of these symbols. The reader is referred to Treatises on Chemistry for more complete information on this subject.

PART VIII.

ROCKS OR MINERAL AGGREGATES.

HAVING treated, in the foregoing pages, of the several mineral species, it will not be out of place, although unusual in Mineralogical treatises, to give a brief account of the various compounds or aggregates of these minerals that occur in nature; in other words, the *Rocks* that constitute the solid strata of our globe, which, though sometimes composed of a simple mineral, consist, in general, of two or more species in intimate combination.

These rocks are either of *igneous* or of *aqueous* origin, or have *proceeded from the two causes combined*; that is, they are either the result of fusion by heat, like lavas, or of deposition from water, like sandstones and many limestones; in which latter case, they are called *sedimentary rocks*; or they are sedimentary rocks altered and rendered more or less *crystalline* by the influence of heat subsequent to their deposition. The last two divisions, as well as the first and third, pass into one another so imperceptibly, that the line of separation cannot always be distinctly drawn.

We treat first of the *crystalline rocks*, including the first and third of the above divisions; next, the *uncrystalline sedimentary rocks*, or those that have not been rendered crystalline by heat.

I. CRYSTALLINE ROCKS.

Granite is a familiar example of the crystalline rocks. It consists of the three minerals, quartz, feldspar, and mica. These minerals were in fusion together when this igneous rock was forming, and crystallizing simultaneously, produced this crystalline mineral aggregate. In true granite they are easily distinguished—the *quartz* by its glassy appearance and irregular fracture; the *feldspar* by its distinct cleavage, or flat surface of fracture, and semi-opaque, white,

gray, or flesh color; and the *mica* by a bright, shining lustre, and an easy cleavage into thin elastic laminæ.

In many of the rocks of this division, the component minerals cannot be distinguished. The combination is so intimate, that the rock has a uniform homogeneous texture without any distinct traces of crystallization. Such are many basalts and lavas.

The usual characters for distinguishing the rocks of this division, are as follows: The absence of rounded grains or pebbles, or fragments of other rocks; often uniform crystalline texture; or if not crystalline, often a uniform dissemination of small crystals (not metallic) through the rock; or if without crystals or crystalline texture, by transitions into other rocks that are crystalline, or contain crystals uniformly disseminated; and in some instances, by the fusibility of the rock before the blowpipe. Invariable characters of universal application cannot be laid down; the above will generally be sufficient.

Mineral aggregates or rocks do not crystallize or present a regular crystalline structure, like the simple mineral species. Each mineral in their constitution, crystallizes independently; and that which predominates usually gives some appearance of structure to the rock. Crystals of the same mineral forming together, usually take a parallel position; that is, lie with similar extremities, or similar cleavage planes, in the same direction; and owing to this fact, the cleavage of a rock may correspond with that of one of the minerals which constitute it. Feldspar thus gives its own cleavage to granite. In the same manner mica, when abundant, gives a rock a micaceous structure, or causes it to split into thin laminæ. The same is true of hornblende or augite. Beds of trap or basalt often consist of vertical columns, which appear as if formed by a simple crystallization of the basalt. These columns are generally six-sided, but vary from three to eight or nine-sided, and are sometimes six or eight feet across and a hundred feet or more in height. The Giant's Causeway is a noted example. The splitting of the rock into these columnar forms is owing to contraction when cooling from a melted state, (for the basalt was once in fusion,) and the *direction* the fractures took at the time, was probably due to the position which the crystals of one or more of the constituent minerals assumed, when in the act of crystallization. These prisms, therefore, are not properly crystals of basalt. In some instances, basalt has a cleavage parallel with the base of the prism, which is owing to the chrysolite it contains; this mineral, in such instances, lying with the cleavable plane of the crystal horizontal.

The crystalline rocks, exclusive of limestones, are naturally distributed into three series, closely related to one another. 1. The *granitic* series; 2. the *syenitic*; 3. the *talcose* or *magnesian* series. The rocks of the granitic series consist of one or more of the minerals *quartz*, *feldspar*, (or some one of the feldspar family,) and

mica; the rocks of the syenitic series differ from the granitic in containing *hornblende* or *augite*, instead of mica; those of the talcose series contain *talc*, *chlorite* or *serpentine*, *&c.*, instead of mica.

We may remark, in general, with regard to the specific gravity of the different rocks, that it varies necessarily with the proportions of the constituent minerals. The specific gravity of granite and gneiss is nearly that of quartz, or 2·4—2·7; of mica slate, between feldspar and mica, or 2·6—2·9; of syenite, 2·7—3·0; of hornblende and hypersthene rock, nearly that of pure hornblende, or 2·9—3·3; of trap and basalt, nearly the same, or 2·8—3·2, and some ferruginous varieties still higher; of porphyry, trachyte, and clinkstone, nearly that of feldspar, or 2·3—2·7; of granular limestone and dolomite, 2·5—2·9; of sandstones, nearly that of quartz, and when containing iron sometimes above 3; of clays, 2—2·8.

I. GRANITIC SERIES.

a. Quartz, Feldspar, and Mica.

1. *Common Granite.* A coarse or fine crystalline rock, usually of flesh red, gray, or grayish-white colors; also presenting other light shades, depending on the proportion and color of the constituent minerals. The colors are not banded, either in the mountain mass or in hand specimens, the constituent minerals quartz, feldspar, and mica being aggregated promiscuously, and not in parallel planes or layers. Granite has a tolerably easy cleavage in one direction, and one less perfect in another, which assists in quarrying the rock. These cleavages correspond with the cleavages of the contained feldspar, but are not distinct in small specimens; other planes of fracture or seams occur, which appear to be due to a different cause, not yet fully explained. The ingredients of granite vary in their proportions, and the rock is described as *micaceous*, *feldspathic*, or *quartzose*, according as mica, feldspar, or quartz is the predominating mineral. It is called *Porphyritic granite* when the feldspar is uniformly disseminated in large crystals; they appear like white blotches, often of a rectangular shape, over a worn surface of the rock.

The fine-grained rock, of uniform texture, forms the best building material. The coarse is apt to be crumbling, and works less smooth. Pyrites, when present, renders the rock unfit for use, as it decomposes and stains or rusts the surface, besides loosening the grains and causing the rock to fall to pieces.

The more common minerals in granite, in addition to its essential constituents, are garnet, tourmaline, pyroxene, hornblende, epidote, and beryl. Besides these it also contains chrysoberyl, iolite, topaz, spodumene, corundum, acmite, zircon, fluor, calc spar, heavy spar, apatite, Prehnite, carpholite, rutile, sphene, Allanite, Columbite, &c. Also ores of tin, copper, lead, zinc, iron, manganese, bismuth, antimony, cerium, and tungsten.

Gneiss. Gneiss resembles granite in its constitution and general characters; but it contains more mica, and the colors are banded,

owing to the arrangement of the minerals, especially the mica, in parallel planes. In consequence of this structure, the rock splits into coarse slabs, along the planes of the mica, besides having the cross fracture or cleavage of granite. It is often described as a stratified or stratiform granite. A rock intermediate between granite and gneiss is called *gneissoid granite.*

Gneiss is used for building and flagging. It is more easily quarried than granite, requires less trimming on account of its smooth surface of fracture, and is little inferior in beauty.

Its characteristic minerals are garnet and staurotide. Tourmaline is often abundant; also hornblende, kyanite, and graphite. Other gneiss minerals are beryl, emerald, epidote, corundum, Bucholzite, Andalusite, iolite, idocrase, zircon, helvin, cryolite, fluor, apatite, strontianite, calc spar, Prehnite, stilbite, harmotome, chabazite, datholite, molybdenite, &c.—ores of silver, lead, copper, zinc, tin, cerium, bismuth, antimony, nickel, iron.

Mica Slate. Mica slate has a glistening lustre, usually a dark grayish color, and splits into thin slabs or layers. Mica is the predominating mineral, and may generally be distinguished in glistening scales. There is a gradual transition from gneiss to mica slate.

It is a valuable flagging material. A fine compact quartzose variety is used for *whetstones*, and a coarser variety, on account of its infusibility, for *firestones.*

Mica slate often abounds in garnets, staurotide, tourmalines, anthophyllite, hornblende, or graphite. It also contains kyanite, epidote, zoisite, scapolite, augite, beryl, corundum, zircon, axinite, Andalusite, Bucholzite, idocrase, fluor, stilbite, Heulandite, chabazite, blue spar, molybdenite, rutile, sphene, anatase, tin ore, iron pyrites, spathic iron, ores of manganese, iron, lead, zinc, copper, &c.

Argillite. Argillite is usually a slaty rock, of fine texture, with a faintly glistening, or earthy surface of fracture. It is called also *clay-slate.* It presents various shades of color, mostly dark and dull; but sometimes light-grayish, red or purple tints, often black.

Common roofing slate is a variety of argillite. Extensive quarries have been opened at Barnard, Piscataquies, Kennebec, Bingham, and elsewhere in Maine. *Novaculite* or hone-slate is a compact, fine-grained, argillite or clay slate, of a grayish or yellowish color. It is used for hones.

Pyrites is the most common mineral in argillite. It also contains calc spar, satin spar, alum, ores of iron, lead, copper, zinc, and mercury.

b. Quartz, Albite, and Mica.

Albite Granite. Albite differs from common feldspar in containing soda instead of potash. Albite granites have generally a white or grayish white color, and some of them, seen a few yards off, look much like statuary marble. Feldspar and albite are sometimes associated in granite, and in this case, the latter may usually be distinguished by its white color, while the feldspar is grayish or flesh-red.

Albite granite, on account of the soda it contains, is a less durable rock than common feldspar granite.

Albitic granite contains the following minerals: Beryl, tourmaline of different varieties, garnet, [illegible], apatite, pyrochlore, Columbite, yttro-columbite, uranite and other ores of uranium, Gadolinite, Allanite and other ores of cerium, ores of tin, &c The ores of cerium, yttrium, and Columbium are of more frequent occurrence in albitic than feldspathic granites.

c. Quartz and Feldspar, or Albite.

The mica of granite is sometimes wanting, and the rock consists only of feldspar and quartz; it is then called *Granulite* or *Leptynite*, or *feldspathic granite*. *Granulite* is properly a granular compound of these two minerals.

When the feldspar very much predominates over the quartz, the rock is quarried for the manufacture of porcelain. On decomposition it produces the clay called kaolin, which is the principal material in this manufacture.

Graphic Granite. Graphic granite is a feldspar rock, showing when broken in certain directions, points and angular figures of quartz, looking like oriental alphabetic characters.

d. Mica and Quartz.

Arenaceous Mica Slate—Hyalomict. When the feldspar is absent, or nearly so, from mica slate, and the quartz predominates, the rock is called an arenaceous or quartzose mica slate. *Hyalomict* is a granular quartzose rock, rather friable, containing barely mica enough to give it a laminated structure.

e. Quartz.

Granular Quartz. In granite regions it is not unusual to find both feldspar and mica absent from certain districts, and the rock a pure quartz rock, called granular quartz. Its colors are usually gray or grayish-red, sometimes white.

When pure, granular quartz is ground or pounded up for making glass, and also for the manufacture of sand paper. In some places it crumbles on exposure, as at Cheshire, in Berkshire Co., Mass., where it is extensively procured for glass manufactories, and for sawing marble.

Quartz rock contains few minerals. Ores of iron and lead are met with, but the beds are seldom extensive

Besides the above varieties in the granitic series, there are occasionally others, arising from the combination of tourmaline, epidote, garnet, staurotide, scapolite, or graphite, with one or more of the elements of granite. Graphite, or plumbago, is often very abundant in gneiss and mica slate, and sometimes seems to replace wholly the mica, producing a *Plumbaginous* slate.

A grayish scapolite rock, associated with dolomite and mica slate in mountain masses at Canaan, Ct., has lately been analyzed by S.

L Dana, Esq , of Lowell, and found to consist of Silica 53.366, protoxyd of iron 4 499, alumina 10 380, lime 25 804, magnesia 1 624, carbonic acid 4 000, loss 0·327. It is called Canaanite by Mr Dana, who considers it a distinct mineral. The carbonic acid is supposed to proceed from a mixture with carbonate of lime.

II SYENITIC SERIES.

The syenitic series of rocks runs parallel nearly with the granitic. the substitution of hornblende or pyroxene for mica is the principal distinction. With this series the modern lavas are here arranged

a Quartz, Feldspar, and Hornblende.

1. *Syenite.* Syenite resembles granite in appearance. The hornblende which distinguishes it, cleaves with less facility than mica, and the laminæ, moreover, are brittle. The colors of syenite are mostly dark gray.

This is a tougher rock than granite, and is more durable as a building stone. The granite from the Massachusetts quarries is mostly Syenite. The name Syenite is derived from *Syene*, a place in Egypt, where this rock is said to occur

Syenitic Granite. Granite often passes into Syenite by a gradual substitution of hornblende for the mica, and it is not unusual to find the two minerals associated, forming a *Syenitic granite.*

Syenite does not abound in minerals Garnets are often abundant, it also affords hornblende in many of its varieties, beryl, tourmaline, zircon, and molybdenite, also Prehnite, Laumonite, chabazite, calc spar, fluor spar, are sometimes associated with it

2. *Porphyritic Syenite* Like porphyritic granite, Syenite may contain large disseminated crystals of feldspar, in which case it is called *Porphyritic Syenite.*

3 *Syenitic Gneiss* This rock is analogous in structure to ordinary gneiss, and differs only in containing hornblende instead of mica, and its greater toughness in consequence *Hornblende slate* consists principally of hornblende, along with more or less feldspar and quartz. It is a black or greenish-black rock, in which the hornblende is either granular or in slender crystallizations.

Hornblende slate is much tougher than mica slate, and is superior for flagging stones.

4. *Hornblende Rock.—Aphanite.* Aphanite is a compact homogeneous rock, without a trace of crystallization, breaking with a smooth surface, like some compact basalts, or almost like hornstone. It consists of hornblende and quartz or feldspar, in intimate combination, but its hornblendic composition would not be suspected except from its high specific gravity, or from finding transitions into

other rocks which are true Syenites. It is hence sometimes called *Cornean*, (cornéenne,) from the Latin word for *horn*, in allusion to its toughness and compact texture.

b. Labradorite or Feldspar, and Hypersthene.

Hypersthene Rock. Hypersthene differs from common hornblende only in its broad foliated crystallization and its pearly or metallic-pearly lustre. Hypersthene rock is an extremely tough rock, usually having a gneissoid structure, and occurring of gray, green, grayish and brownish-green, and greenish-black colors. The thickly disseminated and foliated hypersthene, readily distinguishes the rock.

c. Feldspar or Albite, and Hornblende.

Trap, Greenstone, Diorite. Trap is a heavy compact rock, usually presenting dark greenish-black, grayish-black, or brownish-black colors. It has commonly a crystalline texture, and breaks with a hackly fracture and little lustre. Other varieties are fine-grained or impalpable, and break with a smooth surface. When it contains disseminated crystals of feldspar, it is called *porphyritic trap*. The name *Diorite* is often restricted to the variety of this rock, consisting of albite and hornblende.

Greenstone is a tough rock, like others of hornblendic composition, and is one of the best materials for macadamizing roads.

d. Feldspar or Labradorite, and Augite.

Basalt, Dolerite. Basalt is closely similar in appearance and specific gravity to greenstone, and often can scarcely be distinguished, except by tracing the rock into the coarser varieties, in which crystals of hornblende or augite may be distinguished; the former showing the rock to be greenstone, the latter basalt. Magnetic or titaniferous iron enters often into the constitution of this rock, but is not an essential ingredient. Chrysolite is a common mineral in the rock, appearing like grains of green bottle-glass disseminated through it.

The colors vary from grayish-blue to black, and when light colored, with the feldspar predominating, which the specific gravity would indicate, it is sometimes called *graystone*. The dark colors are the most common. The texture of basalt is sometimes crystalline, but often quite impalpable, with a smooth fracture.

Dolerite includes the varieties consisting of *Labradorite* and augite. In external characters it can scarcely be distinguished from basalt. *Wacke*, or *toadstone*, is either an earthy basalt, or a rock consisting of basaltic earth recemented.

Both trap and basalt occur in columnar forms, as already described.

In the analysis of basalt, it is subjected to the action of nitric or muriatic acid, and thus separated into a soluble and insoluble portion. The basalt of Wickenstein, thus examined by Löwe, with muriatic acid, afforded him 55·58 per cent. of insoluble product, and 44·42 of soluble, the latter consisting of 39·81 of zeolite or zeolitic minerals, and 4·61 of magnetic iron. The basalt from Stolpen, according to Sinding, consists of 57·736 per cent. soluble in muriatic acid, and 42·264 insoluble. On analysis, the soluble and insoluble portions afforded,

	From Wickenstein—*Löwe.*		From Stolpen—*Sinding.*	
	Zeolitic.	Insoluble.	Soluble.	Insoluble
Silica,	39·13	47·98	39·920	52·62
Alumina,	29·00	9·10	21·266	11·93
Lime,	10·52	14·41	7·857	15·49
Soda,	13·92	——	5·279	——
Potash,	1·43	——	2·795	——
Protoxyd of iron,	——	16·51	Oxyd, 16·800	Peroxyd, 10·63
Magnesia,	——	12·97	4·379	8·26
Water,	7·93	——	2·490	——
	100·93	100·97	100·786	98·93

The zeolite of the Wickenstein basalt is stated by Lowe to be near Thomsonite in composition. According to Girard, who analyzed the same basalt with somewhat different results, it is a mixture of mesolite and nepheline. The rest of the basalt, excluding the magnetic iron, is augite, and according to Girard, the whole consists of Mesotype 22·686, nepheline 22·686, magnetic iron 6·370, augite 48·256.

The Stolpen basalt is inferred from the analysis, to consist of Zeolite 74·837, olivine 12·030, magnetic iron 13·318. The zeolite is supposed to be a mixture of several zeolitic minerals; it approaches, in composition, mesole, Brevicite, and sodalite.

A *Dolerite* from Iceland, analyzed by Auerbach, gave Labradorite 38·18 per cent., and augite 61·82. Girard shows that the only difference between the so-called dolerite and the basalt of Meisner is that the latter contains zeolites.

Amygdaloid. When either basalt or trap contains small nodules, or kernels, disseminated through it, the rock is called *amygdaloid.* The cavities occupied by the kernels, are the air-vescicles that were formed when the rock was in fusion; the material composing the kernels was afterwards infiltrated, by percolating steam or water. The name is derived from *amygdalum*, an almond. A variety in which these kernels are small and round, like large shot, and consist of quartz, has been called *varioloid wacke.* A similar rock is sometimes met with, which contains calcareous kernels.

The following minerals occur in greenstone, basalt, and amygdaloid: Quartz, chalcedony, agate, carnelian, opal, stilbite, natrolite, Heulandite, harmotome, Laumonite, apophyllite, Thomsonite, analcime, datholite, Prehnite, scolecite, mesolite, dysclasite, Pectolite, stellite, epistilbite, Comptonite, chabazite, Brewsterite, Edingtonite, Phillipsite, Poohnahlite, Sodalite, Hauyne, calc spar, spathic iron, chlorite, augite, epidote, feldspar, Labradorite, tabular spar, chrysolite, Greenockite, pyrites, specular iron, magnetic iron, titanitic iron, &c.

Basaltic Lava. The cellular rocks found about volcanoes are called *lavas*, and although wanting the compactness, they often have the composition of ordinary basalt.

e. Feldspar.

Passing from basalts, we come, by a gradual transition, to other igneous rocks, consisting of feldspar alone. The transition may

be observed in some volcanic regions, and the diminution of the augite traced to its final disappearance. For this reason it is deemed proper to place these feldspar lavas in connection with the Syenitic series of rocks.

Porphyry. Porphyry is a compact feldspathic rock, containing disseminated crystals of feldspar, the latter, when polished, forming small angular spots, of a light color, thickly sprinkled over the surface. It breaks with a smooth surface and conchoidal fracture. The rock may be dark green, red, blue, black, and other intermediate shades, and the feldspar crystals may be white, or of the same color with the rock, though usually of a lighter tint.

The green variety is the *oriental verd antique.* Red porphyry is also a beautiful ornamental stone.

Clinkstone—Phonolite. Clinkstone is a compact grayish-blue, brownish, or reddish feldspathic rock, showing often some tendency to lamination, and ringing when struck with a hammer. *Clinkstone porphyry* is a grayish or grayish-blue rock, with disseminated crystals of feldspar. Occurs in volcanic regions.

Composition of Phonolite, from Marienberg near Aussig, by Meyer, and from Whisterschan near Teplitz, by Redlenbacher of Vienna,

	The phonolite as a whole.		Soluble part.	
	Marienberg.	Whisterschan.	Marienberg.	Whisterschan
Silica,	56·652	54·090	43·244	41·220
Alumina,	16·941	24·087	21·000	29·238
Peroxyd of iron,	3·905	Protoxyd, 1·248	7·816	Protoxyd, 2·497
Perox. of mang.	——	0·319	——	0·638
Lime,	1·946	0·687	2·986	1·034
Potash,	9·519	4·244	0·035	3·557
Soda,	2·665	9·216	7·112	12·108
Magnesia,	1·697	1·379	——	1·261
Oxyd of copper,	——	0·012	——	0·025
Water,	4·993	3·279	13·325	6·558
	98·318, M.	98·561, R.	95·518, M.	98·136, R.

The Marienberg phonolite is supposed to contain, besides feldspar, natrolite, and apophyllite, and some anhydrous silicate, (nepheline?) that gelatinizes with acids. Phonolite from Abstrode, analyzed by C. Gmelin, according to him, consists of mesotype, or some allied mineral, and a feldspar containing both soda and feldspar; but the proportions vary much in different phonolites, and some are but slightly attacked by acids.

Trachyte. Trachyte (from τραχυς, *rough*) is the name of a grayish feldspathic rock, breaking with a rough uneven surface, and little or no lustre. It often contains crystals of glassy feldspar and hornblende. When the feldspar crystals are thickly and uniformly disseminated, it is called *trachytic porphyry.*

Berthier found the trachyte of the Puy de Dome to consist of Silica 65·5, alumina 20·0, potash 9·1, lime 2·2, peroxyd of iron 3·0=99·8, which is nearly the composition of pure feldspar.

Pumice, Birnsstein. Common pumice has the same composition as trachyte. It is finely cellular or spongy in its texture, and

often so light as to float. As the minute cells are long and fine, it generally appears to have a fibrous structure. It is found about volcanoes that produce feldspathic lavas, and is rendered so light and cellular through inflation by volcanic steam or gases.

Obsidian. Obsidian or volcanic glass (p. 415) is an allied volcanic rock and not a definite chemical compound or mineral species. Feldspathic lavas afford a glass in which the elements of feldspar predominate, while that, associated with basaltic lavas, consists largely of augite; obsidian is therefore no more a simple mineral than trachyte or pumice. The Fayalite of Gmelin from the Azores, the chlorophæite of Macculloch from Faroe, and the scorilite of Thomson from Mexico, are allied volcanic slags.

The following are the constituents of some of these compounds, according to Brandes, Berthier, Thomson, and Gmelin: (for obsidian and pearlstone, see p. 416.)

	Pumice.	*Pumice.*	*Scorilite.*		*Fayalite.* Sol. part. mur.	*Fayalite.* Insol. part.
Silica,	69·250	70·00	58·02		24·93	58·11
Alumina,	12·750	16·00	16·78		1·84	12·53
Peroxyd of iron,	4·500	0·50	13·32	Prot.	65·84	18·55
Soda,	0·875	—	—	Prot. mang.	2·94	6·67
Potash,	0·875	6·50	—	Ox. cop.	0·60	2·28
Lime,	3·500	2·50	8·62		—	—
Water,	7·000	3·00	2·00		—	—
Sul. and mur. acids,	0·375	—	—	Sulf. iron,	2·77	—
	99·125, Br.	98·50, Bert.	98·74, T.		98·92, G.	98·14, G.

The pumice analyzed has nearly the composition of feldspar. The scorilite may have proceeded from the fusion of Labradorite and augite. Fellenberg analyzed Fayalite with a very different result, proving it a varying compound; it may arise from the fusion of a ferruginous augite and magnetic iron ore, with a little copper and manganese, and some feldspar.

Volcanic Scoria is the slag, or coarsely porous and twisted lava of the volcano; and *volcanic ashes*, the fine sand or dust often ejected in clouds at an eruption. These ashes vary in composition with the nature of the lavas. (For an analysis of the Vesuvian ashes of 1822, by Vauquelin, see Ann. Chim. Phys. xxv, 72; and others of ashes from Guadeloupe, and from Cosiguina, Mexico, by Dufrénoy, see Ann. des M. 3d ser. xii, 355.)

The following minerals occur in lavas and about volcanoes: Chrysolite, augite, hornblende, feldspar, albite, Labradorite, ryacolite, Andesin, anorthite, nepheline, leucite, analcime, mica, meionite, Gehlenite, Humboldtilite, natrolite, sodalite, Haüyne, Humite, idocrase, apatite, garnet, zircon, gypsum, Cotunnite, chlorid, sulphate and sulphuret of copper, specular and titaniferous iron, pyrites, feather alum, soda alum, glauber salt, sal ammoniac, sulphur, boracic acid, carbonic acid, sulphurous acid, sulphuretted hydrogen, muriatic acid, &c.

III. TALCOSE, OR MAGNESIAN SERIES.

In the talcose series, the mica of the granitic series is replaced by some magnesian mineral, as talc, chlorite, or serpentine. This series, like the preceding, passes into feldspathic or siliceous rocks.

a. Quartz, Feldspar, and Talc.

1. *Protogine.* Protogine, or talcose granite, resembles common granite in structure, and differs only in the talc that replaces the mica. It is usually a more fragile rock than granite, and decomposes more readily. On decomposition it affords the clay called kaolin, used in the manufacture of porcelain, (p. 350.) The rock has sometimes the structure of gneiss, constituting then a talcose gneiss.

2. *Talcose slate.* Talcose slate resembles mica slate, but has an unctuous feel, is more brittle, and the lustre is usually less glistening. Its colors are various, from white, through gray and dull greenish shades, to grayish-black.

Talcose Aphanite. Jade Rock. Felsite. This rock much resembles the hornblendic aphanite; in its compactness, and in presenting no trace of crystallization, without an unctuous feel; but it occurs in regions of talcose rocks, and often contains a little talc. It presents light green, grayish-green, greenish-brown, and greenish-black colors, has a hardness between feldspar and quartz, and breaks with sharp edges and a smooth conchoidal surface. It often consists mostly of feldspar, being fusible before the blowpipe like that mineral, and is one of the compact feldspathic rocks that have been called *Felsite.* From its resemblance in color to Jade, it is also designated *Jade Rock*, or *Jade Felsite.*

These rocks pass sometimes into a siliceous cherty rock, without talc, presenting the opaque red and yellow colors of jasper, and occasionally this *jasper rock* expands into an extensive formation.

The following minerals occur in talcose rock and slate: Talc, tourmaline, actinolite, and other varieties of hornblende, quartz, (both the crystalline, chalcedonic, and jaspery varieties,) topaz, euclase, zircon, Dolomite, calc spar, heavy spar, automolite, iron pyrites, and other iron ores, native gold, ores of copper, manganese, lead, and zinc. The deposits of gold are usually in talcose rocks; and the topaz of Brazil has the same origin. Nephrite, or jade, is usually found in talcose regions, and is probably an aggregate rather than a simple mineral. Bloodstone, plasma, prase, and many of the greenish varieties of quartz used as gems, appear to come mostly from this formation.

b. Quartz, Feldspar, and Chlorite.

Chlorite slate. Chlorite slate resembles talcose slate, but has a darker green color, a less soapy feel, and is seldom so fissile. It often abounds in octahedral crystals of magnetic iron, and also contains, frequently, acicular crystals of hornblende.

A chlorite slate from the Tyrol, afforded Varrentrapp, Silica 31·54, alumina 5·44, magnesia 41·54, peroxyd of iron 10·18, water 9·32=98·02.

c. Talc.

Steatite, Soapstone, Potstone. Steatite is nearly pure granular talc, and often contains large foliated crystallizations of this mineral. The usual color is gray, or grayish-green, which becomes oily olive-green when polished. From its very soapy feel, it is usually called *soapstone.*

Steatite forms large mountain beds, and is extensively used, on account of its infusibility, for lining fireplaces and stoves, and for crucibles and furnaces. It is easily carved or turned in a lathe, and made into various ornaments.

Rensselaerite. The Rensselaerite of Prof. Emmons is a smooth, compact, soapy rock, from Jefferson and St. Lawrence Counties, N. Y. (See under Pyroxene, p. 366.)

A magnesian agalmatolite, or figure stone, from China, lately examined by Wackenroder, appears to be a similar compound: he obtained, for its composition, Silica 61·967, magnesia 33·029, peroxyd of iron 0·740, water 3·478=99·214. (J. f. pr. Chem. xxii, 8.)

d. Serpentine, Feldspar, Diallage.

Serpentine rock, Euphotide, or Diallage rock. Serpentine is a dark green rock, presenting the colors and characters given under this species, (p. 309.) When pure, it is soft and easily carved. But the rock varies much in hardness and composition, owing to admixture with other minerals, especially diallage and feldspar, and sometimes hornblende. These minerals are often so intimately combined as not to be distinguished, and in this respect the rock is like compact basalt and many other igneous rocks. An analysis of a serpentine rock from Vermont, by Dr. Jackson, is given on p. 310.

When the diallage and feldspar predominate, or there is little or no serpentine present, the rock is called *diallage rock*, or *euphotide*, a variety of Magnesian Rock, into which serpentine often passes.

The mineral diallage is often disseminated through serpentine in olive-green folia. Chromic iron and asbestus are also common in this rock. Other serpentine minerals are the following: Schiller spar, Brucite, magnesite, kerolite, picrosmine, Saussurite, pyroxene, hornblende, Clintonite, Dolomite, apatite, idocrase, Ilmenite, magnetic iron ore, &c.

IV. CRYSTALLINE LIMESTONES.

Granular Limestone. Granular limestone, often called, also, *primary* limestone, consists of crystalline grains, which give a glistening lustre and a granular fracture to the rock, in which respect it differs from ordinary *compact limestones.* Common white marble, used for building, as a material for monuments, &c., is granular limestone; and the varieties clouded with gray, grayish-brown, bluish, yellowish, or reddish colors, constitute, when polished, the clouded marbles in common use. The finer varieties, with the pure white color and transparency of loaf-sugar, are used in statuary, and called *statuary marble.* Luni and Carrari in Italy, are its most noted localities.

Dolomite. Dolomite has the same characters as common or granular limestone, but instead of being pure carbonate of lime, it contains about 45 per cent. of carbonate of magnesia. It is commonly

more friable or crumbling than pure limestone, and less durable as a building material, yet is extensively used. (For analyses, see p. 248.)

The Granular limestone often contains mica, talc, or other impurities, and the clouded colors above noticed are owing to these disseminated minerals. Asbestus, tremolite, and scapolite are also very common minerals in this formation. Other mineral species afforded by it are as follows: Apatite, chondodrite, pyroxene, tourmaline, sphene, spinel, dysluite, tabular spar, quartz, feldspar, petalite, spodumene, corundum, zircon, epidote, garnet, beryl, idocrase, diaspore, graphite, Clintonite, heavy spar, strontianite, celestine, spathic iron, fluor, pyrallolite, rutile, Franklinite, red zinc ore, Ilmenite, antimony, realgar, ores of iron, &c.

II. UNCRYSTALLINE SEDIMENTARY ROCKS.

I. CONGLOMERATES, SANDSTONES, AND SHALES.

1. *Conglomerates.* Conglomerates consist of fragments of rocks, either rolled or angular, cemented, in general, by silica, lime, or iron. When the fragments are rolled pebbles, the rock is called a *pudding stone;* when angular, a *breccia.*

These rocks are also called *siliceous* conglomerates, when composed of quartzose materials; *granitic* conglomerates, if composed of granite fragments; *calcareous*, *coral*, or *shell* conglomerates, if the fragments are of limestone, corals or shells; *basaltic*, if of basaltic rock; *volcanic*, if of any volcanic rock; *pumiceous*, if consisting of pumice fragments, The *Potomac marble*, of which the columns in the Hall of Representatives at Washington consist, is an example of a calcareous conglomerate. The fragments are water-worn pebbles of limestone, cemented by lime.

Millstone grit is a conglomerate, consisting of siliceous sand and quartz pebbles, firmly cemented together. On account of the hard and gritty nature of the materials and firmness of the aggregation, this rock is often used for millstones, though inferior, for this purpose, to Buhrstones.

2. *Sandstones.* Sandstones consist of agglutinated or cemented sand. They are generally siliceous, that is, consist of quartz sand, but are sometimes composed of granite sand. They are of various colors, from pure white to dark shades of red and brown. Red sandstone, when fine-grained and compact, is sometimes called *freestone.*

Sandstones vary in hardness, from that of the solid quartz rock, to a soft, friable stone, too imperfectly compacted to bear handling. The harder varieties make a durable building stone. The softer, if not too friable, have the advantage of being easily quarried, and as the surface generally hardens on exposure, they are extensively used in building. A fine, even-grained sandstone is used for grindstones and coarse whetstones.

Flexible Sandstone. This is a more curious than useful variety of sandstone, from Villa Rica, South America. It splits out in thin layers or slabs, which bend in the hand by their own weight. The flexibility is scarcely perceptible in small hand specimens, but when a foot or more in length, they may be curved like a bow, without breaking.

Argillaceous sandstones contain more or less clay. As the clay predominates, the rock becomes more and more slaty, and passes into an argillaceous shale, or clay slate.

Other rocks consist of coral sand, shell sand, basaltic sand, &c., and these may be called, for distinction, *sand rocks*; as *coral sand rock*, *basaltic sand rock*, &c.

Sandstones are of various ages, and have been distinguished among Geologists, accordingly, by different names; as *old red sandstone*, *new red sandstone*, *variegated sandstone*, *molasse*, *green sand*, &c., for the particular characters of which, reference may be had to Geological Treatises. The green particles in the *green sand* of the chalk formation, are noticed, and analyses given, under *Green Earth*, page 525.

Tufa. Tufa is a name applied to rocks consisting of volcanic or basaltic sand, earth, or pebbles. The term *trass* is given to a rock in volcanic regions, composed of volcanic mud; and *peperino* to a fine-grained volcanic tufa. *Pozzualana* consists of minute particles of scoria, partially decomposed, and imperfectly cemented. It makes a water cement with lime.

The following minerals occur in sandstones: Gypsum, anhydrite, common salt, calc spar, celestine, heavy spar, spathic iron, pearl spar, boracite and Rhodozite in gypsum beds, quartz crystals, chalcedony, coal, ores of iron, lead, copper, zinc, and mercury.

3. *Shale, or clay slate.* Shales are rocks consisting mostly of clay, and having a slaty structure. We have already noticed a variety of argillaceous rock, from which roof and writing slates are obtained, under *Argillite*, a rock which passes into mica slate, and belongs to the same series: it is sometimes, however, scarcely distinguishable from the shales, except in its more evenly fissile character. The colors of shales are various, generally dark blue or black, but also dull shades of brown, yellow, green, and gray.

Alum slate is a shale containing iron pyrites, the decomposition of which gives rise to alum, which often appears as an efflorescence on the surface of the rock, or in thin seams between the layers. The alum is sometimes a potash or soda alum, but often a simple sulphate of alumina, (feather alum,) or an iron-alum, (sulphate of alumina and iron.)

Bituminous shales have a black color, and are impregnated more or less with bitumen, or bituminous coal.

Gray wacke is a name given to some of the older shales in the Geological series, and also to the sandstones that accompany them.

Clay. The nature and uses of clay are well known. *Potter's*

and *pipe clay* are the finer white varieties, which contain no iron, and on this account do not burn red, like common *brick clay*, or loam. Kaolin, or porcelain clay, has been already noticed. *Common clay* is a mixture of alumina and siliceous sand, and ordinarily contains 20 to 35 per cent. of the former, with 8 to 10 per cent. of iron. Lime is sometimes present, in which case it is properly a marl, and is unfit for pottery or brick making.

Fuller's earth is a white, grayish, or greenish-white earth, having a soapy feel, which was formerly used for removing oil or grease from woollen cloth. It falls to pieces in water and forms a paste which is not plastic. Thomson found a variety of it to consist of Silica 44·00, alumina 23·06, lime 4·08, magnesia 2·00, protoxyd of iron 2·00=100·19. G.=2·448.

Lithomarge, (Steinmark of the Germans,) is a compact clay, of a fine, smooth texture, and very sectile. Its colors are white, grayish, bluish, or reddish-white, or ochre-yellow, with a shining streak. G.=2·4—2·5. The *Tuesite* of Thomson is a white lithomarge, from the new red sandstone on the banks of the Tweed. It is said to make good slate pencils, (Thom. Min. i, 244.)

Tripoli is a fine-grained earthy deposit, having a dry, harsh feel, and a white or grayish color. G.=1·857. It contains 80 per cent. of silica, mostly derived, as Ehrenberg has shown, from the casts of animalcules, and is used as a polishing material.

Septaria. Septaria is a vague term in Mineralogy, and is usually applied to any concretionary nodules imbedded in clay or sand. It properly includes only certain concretions which are subdivided by seams into small areas. The name is from *septum*, a division.

Pipe stone, Catlinite. The pipe stone of the North American Indians is usually a variety of clay stone, or argillite; occasionally soapstone, or serpentine. In Northern Oregon, it is a compact argillite, of a grayish-blue or grayish-black color; a specimen from this region, analyzed by Thomson, afforded Silica 56·11, alumina 17·31, magnesia 0·20, peroxyd of iron 6·96, soda 12·48, lime 2·16, water 4·58=99·80. G.=2·607. (Min. i. 287.) A red claystone, from the Coteau de Prairies, highly prized by the Indians of that region as a material for pipes, has been named *Catlinite*, by Dr. C. T. Jackson, who analyzed a specimen with the following result: Silica 48·2, alumina 28·2, magnesia 6·0, peroxyd of iron 5·0, oxyd of manganese 0·6, carbonate of lime 2·6, water 8·4, loss (probably magnesia) 1. (Sill. J. xxxv, 388.) It is allied to agalmatolite, and is an aggregate, or rock, and not a simple mineral.

II. COMPACT LIMESTONES.

Compact limestones are opaque rocks, without much lustre, easily scratched with a knife, and effervescing freely with an acid. Gray, grayish-blue, and black, are common colors, and shades of light yellow, brown, and cream-color, sometimes occur. All these va-

rieties admit of a good polish, and constitute the common marbles in use. The colors are sometimes veined, or clouded, producing marbles of great beauty.

Bird's-eye marble is a slate-colored rock, with disseminated crystalline points. It is abundant in Western New York. *Shell marble* consists largely of fossil shells, and *encrinal marble* of the joints of encrinites. *Lumachelle*, or *fire marble*, is a shell marble, presenting internal reflections of brilliant iris or opal hues, proceeding from the surfaces of some of the imbedded shells. *Ruin marble* presents tracings in brown, on a grayish-yellow ground, which represent scenes of castles, towers, or cities, in ruins. These markings proceed from the infiltration of iron.

The following minerals occur in compact limestone: Calc spar, pearl spar, Dolomite, spathic iron, celestine, Strontianite, heavy spar, Witherite, gypsum, anhydrite, fluor, quartz, opal, ores of lead, iron, copper, zinc, &c.

Magnesian limestone. Compact limestones often contain a large amount of magnesia, and are then called *magnesian limestones.* This term, however, is usually restricted, by Geologists, to one of the secondary limestones above the coal formation. The limestones of our country sometimes contain 30 to 40 per cent. of carbonate of magnesia.

Hydraulic limestone. This variety is an impure limestone, containing a variable quantity of clay or silica, and sometimes a large proportion of magnesia. The French varieties afford, on analysis, but 2 or [illegible] per cent. of magnesia, and 10 to 20 per cent. of clay, or silica and alumina. Our own hydraulic limestones contain 20 to 40 per cent. of magnesia, and 12 to 30 per cent. of silica and alumina, or clay. A variety worked extensively at Rondout, N. Y., afforded Prof. Beck, Carbonic acid 34·20, lime 25·50, magnesia 12·35, silica 15·37, alumina 9·13, peroxyd of iron 2·25, bituminous matter, moisture, and loss 1·20. (Min. N. Y. p. 78.)

The property of hardening under water, which the lime from this rock possesses, appears to be due, principally, to the silica, or silica and alumina, in its composition. The silica is in a finely divided state, disseminated uniformly through the lime, and is thus in a favorable condition to combine with the lime at once, when water is added. The strength of common mortar depends on the formation of a silicate of lime (or of lime and alumina) from a combination of the lime with the sand (silica) that is added, and the quality of the mortar may be improved by selecting the cleanest and *finest* sand.

Chalk. Chalk is a white earthy limestone.

Oolitic limestone, or *Oolite*, consists of minute rounded grains, like the spawn of a fish in size, whence the name, from ὠον, *an egg*.

Other limestones are distinguished by the Geologist, as mountain limestone, lias limestone, carboniferous limestone, and in our own country, Trenton limestone, Niagara limestone, &c.; but the distinctions depend on difference in geological age, and not on mineral characters.

Travertine, calcareous tufa. Travertine is a recent calcareous deposit, formed from waters charged with carbonate of lime, by the gradual deposition of the lime. Extensive beds of hard limestone are occasionally thus formed. The softer deposits of a chalky nature, are called *calcareous tufa.* They are common in limestone caverns.

Marl. The term marl is often applied to any friable clay, or loam, especially if used for fertilizing land. The green sand in New Jersey is commonly so called. But, strictly, the term includes only a calcareous clay, or earth, or beds of earth containing recent shells. The proportion of calcareous matter in marls, varies from 10 to 90 per cent. *Indurated marl,* as the name implies, is a consolidated marl, which consolidation may take place from cementation by lime or iron.

PART IX.

MINERALOGICAL BIBLIOGRAPHY.

THE following is an abstract of a more extended manuscript catalogue of mineralogical works, collected from various sources, by the author The arrangement is chronological, each author receiving his place in the list, with the date of his first printed work

FOREIGN

Plinii secundi, (Caii)—Naturalis Historia First printed in large fol at Venice, 1469 Numerous editions of this work have appeared since at various times and places

Alberti Magni Philosophorum maximi de Mineralibus, Libri V *Patavii*, 1476

——— De Mineralibus et rebus metallicis, Libri V 8vo 1541, 1569

Agricola, G—De Re metallica Libri XII, et de Natura Fossilium, Libri X Fol *Basiliæ*, 1546 Reprinted at various times and places since

Boetius de Boot—Gemmarum et Lapidum historia, quam olim edidit Ans B de Boot, postea Adrianus Tollins recensuit Tertia Edit longe purgatissima Cui accedunt Jo de Laet, de gemmis et lapidibus Libri II, et Theophrasti liber de Lapidibus 8vo *Lugduni Batavorum* 1647

Libavii, (Andr)—Singularium Libr IV quorum I et III de metallis lapidibus, et fossilibus 8vo *Francof* 1549, also in 1601

Encelius, Christ—De re metallica Libri III 8vo *Francof* 1551, also in 1552 and 1557

Theophrasti, (Eresii)—Opera omnia, Græce, cura Camotii edidit F Turrisanus 8vo *Venetiis*, apud Aldi filios, 1552 Various editions have appeared since

Gesneri, (C)—De omni rerum fossilium genere, gemmis, lapidibus, metallis, &c 8vo *Tiguri*, 1565

Fabricius, G—De metallicis rebus et nominibus obs var crud quibus ea potissimum explicantur quæ G Agricola præterit 8vo *Tiguri*, 1566

Cæsalpin, A—De re metallica 4to *Romæ*, 1596

Avicennæ Opera *Romæ*, 1593 *Venetiis*, 1608

Aldrovandi (Ulyssis) Opera omnia 13 vols fol with several thousand wood cuts *Bononiæ*, 1599—1668

Ferrante Imperator—De fossilibus opusculum 4to *Napoli*, 1610

Cæsius, Bernardus—De Mineralibus, 650 pp fol *Lugduni*, 1636

Laet, Jo de—De Gemmis et Lapidibus, Lib II Gr et Lat Paris, 1647

Lovell, Robert—Panzoologicomineralogia, or a history of animals and minerals 12mo *Oxford*, 1661.

Johnson, J—Notitia Regni mineralis, sive Catalogus subterraneorum cum præcipuis differentiis 12mo *Lipsiæ*, 1661

Kircheri, (Athanasii)—Mundus subterraneus in Libros XII, digestus 2 vols in 1, with plates and portraits of Kircher and Pope Alexander, fol *Amsterdam*, 1665

Konig, Em—Regnum Minerale, physice, medice, anatomice, chemice, investigatum, perscrutatum, erutum 4to *Basiliæ*, 1686, also in 1703

Hiaernc, Urban.—Kort Anledning til äskillige Malm och Bergarters, Mineraliers, etc.; eftersporjande och angifvande. *Stockholm*, 1694.
Gulielmini.—De Salibus dissertatio physica, medico-mechanica. *Venetiis*, 1705.
Chambon.—Traité des Metaux et des Minéraux. 12mo. *Paris*, 1714.
Henckel, J. Fr.—Pyritologia. 8vo. *Lipsiæ*, 1725.
——— Idea generalis de Lapidum origine. 8vo. *Dresd. et Lips.* 1734.
——— In Mineralogia redivivus. 8vo. *Dresdæ*, 1747.
Woodward, Dr. J.—Fossils of all kinds digested into a method suitable to their mutual relation and affinity. With plates. *London*, 1728.
——— An attempt towards the Natural History of the fossils of England, in the collection of J. Woodward. 2 vols. 8vo. *London*, 1728.
Bromel, Magn. von.—Inledning til nödig Kundskap om Bergarter, Mineralier, Metaller, samt Fossilier. 8vo. *Stockholm*, 1730.
Swedenborgius (Emanuel.)—Opera Philosophica et Mineralia. 3 vols. fol., with numerous plates. *Paris*, 1742.
Linnæus, C.—Systema Naturæ sive tria regna. Ed. I. fol. *Lugd. Bat.*, 1735. Ed. XII., *Holmiæ*, 1766.
Bouguet.—Sur le formation des sels et des crystaux. 12mo. *Paris*, 1729.
D'Argenville, A. J. Desalliers—L'Historia Naturelle éclaircie dans deux de ses parties principales, La Lithologie, et La Conchyliologie. Roy. 4to., with numerous plates. *Paris*, 1742.
Pott, J. H.—Chemische Untersuchungen, welche vornehmlich von der Litheognosie handeln. 4to. *Potsdam*, 1746; also 1751—54 and 1757.
——— Lithcogeognosie, ou examen chymique des pierres et des Terres en general. *Paris*, 1753.
Wallerius, J. G.—Mineralogia eller Mineral Ricket indelt och beskrifvet. 8vo. *Stockholm*, 1747.
——— Lucubrationum academicarum specimen primum de systematibus mineralogicis et systemate mineralogico rite condendo. 8vo. *Holmiæ*, 1768.
——— Systema Mineralogicum, quo Corpora Mineralia in classes, ordines, genera et species, suis cum var. divisa describuntur atque observationibus, experimentis et figuris illustrantur. 2 vols. 8vo. *Vindob.* 1778.
Da Costa, E. Mendes.—Natural History of Fossils. 4to. *London*, 1756.
Hill, Sir John.—The History of Fossils. Fol. *London*, 1748.
Woltersdorf, J. L.—Systema minerale in quo regni mineralis producta omnia systematica per classes, ordines, genera, et species proponuntur. 4to. *Berlin*, 1738; also 1753—4 and 1755—8.
Cartheuser—Elementa Mineralogiæ systematice disposita. 8vo. *Francof.* 1755.
Salerne.—L'Oryctologie. 4to. *Paris*, 1755.
Justi, J. H. G.—Grundriss des gesammten Mineralreichs, 8vo. *Göttingen*, 1757; also in 1765.
Cronstedt, Axel von.—Försök til Mineralogia eller Mineral-rikets Upställning. 8vo. *Stockholm*, 1758.
Bomare, Valmont de.—Prospectus d'un cours sur l'histoire naturelle des Minéraux. 12mo. *Paris*, 1759.
——— Mineralogie, ou nouvelle exposition du Regne Minérale. 8vo. *Paris*, 1762; also in 1769, 1774, 1780.
Gronovius, L. T.—Bibliotheca Regni Animalis et Lapidei. 4to. *Lugd. Bat.*, 1760.
Vogel, R. A. Præs.—Terrarum atque lapidum partitio, resp. A. Fr. Hempel. 4to. *Göttingen*, 1762.
Walch, J. E. J.—Das Steinreich systematisch entworfen. 2 vols. 8vo. 24 pl. *Halle*, 1762.
Bertrand, E.—Dictionnaire universel des fossiles propres et des fossiles accidentels, contenant une description des Terres Sables, &c. 8vo. 2 vols. in 1. *La Haye*, 1763.
——— Recueil de divers Traités sur l' Histoire Naturelle de la Terre et des Fossiles. 4to. *Avignon*, 1766.
Forster, J. R.—Classification of Fossils and Minerals. *London*, 1768; also in 1772.
Scopoli, J. A.—Einleitung zur Kenntniss und Gebrauch der Fossilien. 8vo. *Riga* und *Milan*, 1769.
——— Principia Mineralogiæ systematicæ et practicæ. *Pragæ*, 1772.
Lehman, J. A.—Entwurf einer Mineralogie. 8vo. *Frankf.* et *Leip.* 1757; also in 1769 and 1791.
Bourguet.—Du Regne Minerale. 4 vols. 12mo. *Paris*, 1771.
Romé de L'Isle.—Essai de Cristallographie. 8vo. *Paris*, 1772. 2d ed. in 4 vols. 8vo. 1783.

Gerhard, C. A.—Beiträge zur Chemie und Geschichte des Mineralreichs. 2 vols. 8vo. *Berlin*, 1773—1776; also in 1781.
——— Grundriss des Mineralsystems. 8vo. *Berlin*, 1786 and 1797.
Sage.—Mineralogie docimastique; with plates. 8vo. *Paris*, 1772; also in 2 vols. in 1777.
Schröter, J. S.—Journal für die Liebhaber des Steinreichs. *Weimar*, 1774.
Werner, Abr. G.—Von der ausserlichen Kennzeichen der Fossilien. 8vo. *Leip.*, 1774.
——— Letztes Mineral-System. 8vo. *Freyberg*, 1817.
Vogel, R. A.—Practisches Mineralsystem. 2d ed. 8vo. *Leip.*, 1776.
Gobet.—Les Anciens Mineralogistes du Royaume de France. 2 vols. 8vo. *Paris*, 1779.
Fichtel, J. C. Von.—Mineralgeschichte. 4to.; with plates. *Hamburg*, 1780.
Lenz, J. G.—Tabellen über das gesammte Steinreich. 4to. *Jena*, 1781.
——— Mineralogisches Handbuch durch weitere Ausführung des Wernerschen Systems. 8vo. *Hildburghausen*, 1791.
——— Vollstandig Einleitung zur Kenntniss der Mineralien. 2 vols. 8vo. *Leipz.* 1794.
——— System der Mineralkörper. 8vo. *Bamberg* und *Wurzb.* 1800; also in 1809.
——— Erkenntnisslehre der Anorganischer Naturkörper. *Geisen*, 1813.
M. Buffon, Le Comte de.—Histoire Naturelle des Minéraux. 4to. *Paris*, 1783.
Bergmann, T.—Sciagraphia regni mineralis secundum principia proxima digesti. 8vo. *Lipsiæ*, 1782, and *London*, 1783.
Faujas de Saint Fond, B.—Minéralogie des Volcans, ou Description de toutes les substances produits ou rejetées par les feux souterrains. Royal 8vo. *Paris*, 1784.
Kirwan, R.—Elements of Mineralogy. 8vo. *London*, 1784; 2d ed., 1794.
Daubenton.—Tableaux méthodique des Minéraux suivant leurs differentes natures. 4to. *Paris*, 1784.
Well, J. J. Von.—Methodische Einleitung der mineralogischen Körper. 8vo. *Wien*, 1786.
Cavallo, Tib.—Mineralogical Tables; fol. *London*, 1786.
Schöpf, J. D.—Beyträge zur Mineralogischen Kenntniss des östlichen Theils von Nordamerika, und seiner Gebirge. 8vo. 1787.
Walker.—Classis Fossilum, sive characteres Naturales chymici classium et ordinum in Systemate Minerali. 8vo. *Edinburgh*, 1787.
Fibig.—Handbuch der Mineralogie. 8vo. *Mainz* und *Frankf.*, 1787.
Volta, Ab.—Elementi di Mineralogia analitica e sistematica. 8vo. *Pavia*, 1787.
Batsch, A. J. G. K.—Versuch einer Anleitung zur Kenntniss und Geschichte der Thiere und Mineralien. 2 Bde. 8vo. *Jena*, 1788, 1789; also 1796—1800.
Williams, John.—Natural History of the Mineral Kingdom. 2 vols. 8vo. *Edinburgh*, 1789.
Schall, C. F. W.—Anleitung zur Kenntniss der besten Bücher in der Mineralogie. 2d ed. 8vo. *Weimar*, 1789.
De Born.—Catalogue de la collection des Fossiles de Eleonore de Raab. 2 vols. 8vo. *Vienna*, 1790.
Suckow.—Anfangsgründe der Mineralogie. 8vo. *Leipzig*, 1790; 2d ed. 2 vols. 8vo. 1803—4.
Gallitzin, Le Prince Dimitri de.—Traité ou Description abrégée méthodique des Minéraux. 4to. *Maestricht*, 1792.
Karsten, D. L. G.—Tabellarische Uebersicht der mineralogischen einfachen Fossilien. 8vo. 2te Aufg. *Berlin*, 1792; also 1800, 1808.
Klaproth, Martin Heinrich.—Beyträge zur Chemischen Kenntniss der Mineralkörper. 3 B. 8vo. *Berlin*, 1795—1802.
Emmerling, L. A.—Lehrbuch der Mineralogie. 8vo. *Giezen*, 1793.
Veltheim, A. V. Von.—Reformen in der Mineralogie. 8vo. *Helm.*, 1793.
Schmeisser, J. G.—System of Mineralogy. Vol. 1. 8vo. *London*, 1794.
Wiedenmann.—Handbuch der Oryktognostichen Theils der Mineralogie. 2 vols. 8vo. *Leipzig*, 1794.
Del Rio, Don Andres Manuel.—Elementos de Oryktognosia ò del conocimiento de los fossiles, dispuestos segun los principios de A. G. Werner. 4to. *Mexico*, 1795.
——— Nuevo sistema Mineralo. *Mexico*, 1827.
Retzius, A. J.—Försök til Mineral-Rikets Upställning. 8vo. *Lund*, 1795.
Forster, J. R.—Onomatologia nova systematis oryktognosiæ, vocabulis Latinis expressa. Fol. *Halæ*, 1795.
Babington.—A Systematic Arrangement of Minerals. 4to. *London*, 1795; 1799.
Struve, H.—Méthode Analytique des Fossiles, fondée sur leurs Caractères Exterieurs. 8vo. Lausanne, 1797; 8vo. *Paris*, 1798.
Napione.—Elementi di Mineralogia. 1 vol. 8vo. *Turin*, 1796.

Townson, R.—Philosophy of Mineralogy. 8vo. plates. *London*, 1798.
Reuss, F. A.—Lexicon Mineralogicum, sive Index Latino-Gallico-Suecico-Danico-Anglico-Russico-Hungarico-Germanicus Mineralium. 8vo. *Leip.*, 1798.
——— Lehrbuch der Mineralogie nach Karsten's Tabellen. 8vo. *Leipzig*, 1801; 1806.
Jameson, Robert.—Mineralogy of the Scottish Isles. Maps and plates; 2 vols. 4to. *Edinburgh*, 1800.
——— System of Mineralogy. 2 vols. pl. 8vo. *Edinburgh*, 1804; 2d ed. 3 vols. 8vo. 1816; 3d ed. 1818.
——— A Treatise on the External Characters of Minerals. 8vo. *Edinburgh* and *London*, 1804—1805.
——— A Manual of Mineralogy, (from the Encyclopedia Britannica.) *Edinburgh*, 1837.
Brunner, J.—Versuch einer neuen Systems der Mineralogie. 8vo. *Leipzig*, 1800.
Haüy, L' Abbé.—Traité de Minéralogie. 4 vols. 8vo. *Paris*, 1801—2.
——— Tableau comparatif des résultats de la Cristallographie et de l' analyse chimique, relativement à la classification des minéraux. 8vo. figs. *Paris*.
——— Traité des caractères physique des pierres. 8vo figs. *Paris*, 1817.
——— Traité de Crystallographie. 2 vols. 8vo. *Paris*, 1822.
——— Traité de Mineralogie. 4 vols. 8vo. *Paris*, 1822.
Brochant de Villiers, A. J. M.—Traité élémentaire de Minéraux suivant les principes de Werner. 2 vols. 8vo. *Paris*, 1801; also 1808.
——— Sur la cristallisation geometriquement et physiquement considerée. With numerous plates. 8vo. *Strasburg*, 1819.
Hoff, A. Von.—Magazin für die gesammte Mineralogie, &c., pl. 8vo. *Leipz.*, 1801.
Mawe.—Mineralogy of Derbyshire. 8vo.; plates. *London*, 1802.
Sowerby.—British Mineralogy. 8vo. *London*, 1802; 1817.
Dolomieu, D. de.—Sur la Philosophie Minéralogique et sur l'espéce Minéralogique. 8vo. *Paris*, 1802.
Hausmann, J. F. L.—Krystallogische Beiträge. 4to. Pl. 1803.
——— Untersuchungen über die Formen der leblosen Natur Ir. Bd. 4to. mit vielen Kupfern. *Göttingen*, 1821.
——— Entwurf eines Systems der unorganisirten Naturkörper. 8vo. *Cassel*, 1809.
——— Handbuch der Mineralogie. 3 vols. 8vo. *Göttingen*, 1813; 2d edit. 1828.
——— Specimen Crystallographiæ Metallurgicæ. 4to. *Göttingen*, 1829.
Ludwig, C. F.—Handbuch der Mineralogie nach A. G. Werner. 8vo. *Leipzig*, 1803.
Lucas, J. A. H.—Tableau Méthodique des espèces minerales. 8vo. *Paris* and *Strasb.*, 1803.
Schwarz, G. M.—Handbok i Oryktognosien. 8vo. 1803.
Launnas, L. de.—Minéralogie des Anciens. 2 vols. 8vo. *Bruxelles* and *Paris*, 1803.
Rozin.—Essai sur l' étude de la Minéralogie. 8vo. 368 pp. *Bruxelles*, 1803.
Mohs, Friederich.—Handbuch der Oryktognosie. 3 vols. 8vo. *Wien*, 1804.
——— Die Charaktere der Classen, Ordnungen, Geschlechten und Arten, oder die Charakteristik der naturhistorischen Mineralsystems. 8vo. *Dresden*, 1821.
——— Der Naturgeschichte des Mineralreichs. *Wien*, 1832; 2d ed. 1839—41.
Accum, F.—Elements of Crystallography, after the manner of Haüy. 8vo. plates. *London*, 1804.
——— Analysis of Minerals. 12mo. *London*, 1804.
——— Manual of Analytical Mineralogy. 2 vols. pl. *London*, 1808.
——— System of Mineralogy and Mineralogical Chemistry. 4 vols 8vo. *London*, 1810.
Haberle, C. C.—Beiträge zu einer allgemeinen Einleitung in das Studium der Mineralogie. 8vo. *Weimar*, 1805.
——— Characterisirende Darstellung der Mineralien mit Hinsicht auf Werner und Hauy's beobachtungen. 8vo. *Weimar*, 1806.
Turton, William.—An edition of Linnæus's *Systema Naturæ*, containing, in one volume, a General System of the Mineral Kingdom. 8vo. *London*, 1806.
Leonhard, C. C., R. F. Menz, und J. H. Kopp.—Systematisch-Tabellarische Uebersicht und Characteristik der Mineralkörper. 2 vols. fol. *Frankfort*, 1806; 2d edit. 1817.
——— Taschenbuch für die gesammte Mineralogie mit Hinsicht auf die neueste Entdeckungen. 8vo. 1807.
——— Handbuch der Oryctognosie. 8vo. *Heidelberg*, 1821; 2d edit. 1826.
Lucas, J. A. H.—Tableau Méthodique des Espèces Minérales. 8vo. *Paris*, 1806; 1813.
Brongniart, Alex.—Introduction à la Minéralogie. 8vo. *Paris*, 1807; 2d ed. in 1824.
Brard, C. P.—Manuel du Minéralogiste. 12mo. *Paris*, 1808; 2d edit. 1824.
——— Minéralogie appliquée aux arts. 3 vols. 8vo. *Paris*, 1821.

Brand, C. P.—Description historique de sa collection de Minéralogie appliquée aux arts. 8vo. *Paris*, 1833.
——— Nouveaux elements de Minéralogie, ou Manuel du Minéralogiste voyageur. 3d ed. 8vo. 1838.
Kidd, J.—Outlines of Mineralogy. 2 vols. 8vo. *Oxford.*
Weiss.—De indagando formarum crystallinarum charactere geometrico principali. *Lipsiæ*, 1809.
Nuzlein, F. A.—Versuch eine neuen Systems der mineralogisch-einfachen Fossilien. *Bamberg* und *Wurzburg*, 1810, 1812.
Hoffmann, C. A. E.—Handbuch der Mineralogie mit Fortsetzung von A. Breithaupt. 4 vols. *Freyberg*, 1811; 1818.
Chenevix, R.—On Mineralogical Systems. 8vo. *London*, 1811.
Steffens—Vollstandiges Handbuch der Oryktognosie. 4 vols. 8vo. *Halle*, 1811; 1824.
Bournon, Comte de—Catalogue de sa collection Minéralogique. 8vo., with 4to. plates 1813.
——— Traité complète de la chaux carbonatée, et de l' Arragonite. 3 vols. 4to. *London*, 1808.
Aiken, Arthur.—Manual of Mineralogy. 8vo. *London*, 1814.
Allan.—Mineralogical Nomenclature. 8vo. *London*, 1814.
Gravenhorst, J. L. C.—Handbuch der Anorganognosie. 8vo. *Leipzig*, 1815.
Berzelius, J. J.—Versuch durch Anwendung der elektrisch chemischen Theorie und der chemischen Verhältnisslehre, ein rein wissenschaftliches System der Mineralogie zu begründen. Aus dem Schwed. von Dr. A. F. Gehlen. 8vo. *Nürnberg*, 1815.
——— Neues System der Mineralogie, aus dem Schwedischen von Dr. Gmelin und Pfaff. 8vo. *Nurnberg*, 1816.
——— Die Anwendung des Löthrohrs in der Chemie und Mineralogie; Aus der Handschrift ubersetzt von Heinr. Rose. 8vo. *Nurnberg*, 1821. edit. 8vo. 1837.
——— The same, translated by J. G. Children. 8vo. 3 pl. *London*, 1822.
——— The same in French, by Fresnel, 8vo. *Paris*, 1821; and by Valerius, *Brussels*, 1835.
Tondi.—Elementi di Orittognosia. 2 vols. 8vo. *Napoli*, 1817.
Phillips, Wm.—Outlines of Mineralogy and Geology. 3d edit. 8vo. *London*, 1818; 4th edit. 1826.
——— An elementary introduction to the knowledge of Mineralogy. 8vo. *London*, 1823, also 1837.
Bakewell, R.—Introduction to Mineralogy. 8vo. *London*, 1819.
Kick, Z.—Tentamen Mineralogicum, seu Mineralium nova distributio in classes, ordines, genera, &c. 8vo. *Bruxelles*, 1821.
Koratz, Michel.—Lexicon Mineralogicum, enneaglottum. 8vo. *Pest.* 1821.
Stromeyer.—Untersuchungen über die Mischung der Mineralkörper. *Göttingen*, 1822.
Du Menil.—Disquisitiones Chemicæ nonnullorum fossilium. *Schmalkalden*, 1822.
——— Chemische analysen Anorganischer Körper, 1st B. *Schmalkalden*, 1823.
Neumann.—Beiträge zur Kristallonomie. 8vo. *Berlin*, 1823.
Koch, M. F.—Beiträge zur Kenntniss krystallin Hüttenproducte. 8vo. *Göttingen*, 1823.
Breithaupt, A.—Vollstandige Charakteristik des Mineral-systems. 8vo. *Dresden*, 1823 2d edit. 1840.
——— Physiologie der unorganischen Natur. 8vo. pl. *Dresden*, 1828.
Renier, S. A.—Elementi di Mineralogia. 8vo. *Padua*, 1823.
Brooke, H. J.—A familiar Introduction to Crystallography, 508 pp. 8vo. *London*, 1823.
Beudant, F. S.—Traité élémentaire de Minéralogie, 8vo. plates. *Paris*, 1824. 2d edit. in 2 vols. 8vo. 1830.
Stchégloff, N.—Mineraloguia po sistémiè Gospodinda Haüy. 2 vols. 8vo. *St. Petersburg*, 1824.
Haidinger, Wm.—Treatise on Mineralogy, or the Natural History of the Mineral Kingdom; translated from the German of Mohs. 3 vols. 8vo. *Edinburgh*, 1825.
Monticelli and Covelli.—Atlante della Mineralogia Vesuviana. 19 pl. *Napoli*, 1825.
Blondeau.—Manuel de Minéralogie. 18mo. *Paris*, 1825; 2d edit. 1828.
Marx, Dr. C. M.—Geschichte der Krystallkunde. 8vo. *Carlsruhe* und *Baden*, 1825.
Hisinger.—Mineralgeographie von Schweden, nach der Handschrift zur zweiten Aufl. übersetzt von Wöhler. *Leipzig*, 1826.
Naumann, C. Fr.—Entwurf der Lithurgik oder ökonomischen Mineralogie. 8vo. *Leipzig*, 1826.
——— Grundriss der Krystallographie. 8vo. *Leipzig*, 1826; 2d edit. 2 vols. 1830

Naumann, C. Fr.—Lehrbuch der Mineralogie. 8v. *Berlin*, 1828.
——— Anfansgrunde der Krystallographie (19¼ Bogen) mit 25 lithogr. Tafeln. *Dresden* und *Leipzig*. 8vo. 1841.
Rau, Ambros.—Lehrbuch der Mineralogie. 8vo. *Wurzberg*, 1826.
Girardin et Lecoq.—Elémens de Minéralogie appliquée aux science chimique. 2 vols. 8vo. pl. *Paris*, 1826.
Drapiez.—Minéralogie Usuelle. 504 pp. 12mo. *Paris*, 1826.
Bredsdorf, J. H.—De notione speciei in regno minerali. 104 pp. 12mo. *Copenhagen*, 1827.
Desnos, J. O.—Precis de Minéralogie Moderne. 2 vols. 32mo. pl. formant 20 and 21 livr de l'Encyclopédie portative. *Paris*, 1827.
Griffin, J. J.—Practical Treatise on the use of the Blowpipe. 8vo. *Glasgow*, 1827.
——— On Chemical Manipulation and the use of the Blowpipe. 8vo. *Glasgow*, 1837.
A System of Crystallography with an application to Mineralogy. 500 pp. 8vo. *Glasgow*, 1841.
Glocker, Dr. E. F.—Grundriss der Mineralogie. 8vo. *Breslau*, 1827.
——— Uebersicht der Kristallisations-systeme, etc. 48 pp. 4to. *Breslau*, 1829.
——— Handbuch der Mineralogie fur Vorlesungen und zum Privatgebrauch bestimmt, 1829.
——— Handbuch der mineralogie. 5 vols. 8vo. pl. *Nurnberg*, 1831.
——— Grundriss der Mineralogie, mit Einschluss der Geognosie und Petrefaktenkunde, fur höhere Lehr anstalten, und zum Privat-Gebrauche. xxxiv und 993 pp. 8 lith. 8vo. 1839.
Bernhardi.—Beiträge zur Kenntniss der Kristallformen. *Erfurt*, 1827.
Hartmann, C. F. A.—Mineralogie, 8vo. pl. *Ilmenau*, 1828; also in 1831.
——— Repertorium der Mineralogie. 8vo. pl. *Leipzig*, 1831,
——— Grundzuge der Mineralogie und Geologie. 8vo. *Nurnberg*, 1835.
Friesleben, J. Ch.—Magazin fur die Orictographie von sachsen. 8vo. *Frieberg*, 1828.
Grasman, J. Gunter.—Zur physischen Krystallonomie, und geometrischen Combinationslehre, in 8vo. 184 pp. 3 pl. *Stettin*, 1829.
Frankenheim, M. L.—De Crystallorum cohæsione. *Breslau*, 1829.
——— Die Lehre von der Cohäsion, umfassend die Elasticität der Gase, die Elasticität und Cohärenz der flüssigen und sesten Körper und die Krystallkunde. 502 pp. 8vo. *Breslau*, 1835.
——— System der Krystalle. *Breslau*, 1842.
Haidinger, Wm.—A fangsgrunde der Mineralogie. 15 pl. *Leipzig*, 1829.
——— Bericht über die Mineralien sammlung der K. K. Hoffkammer in Munz- und Bergwesen. 4to. *Vienna*, 1843.
Bergemann, C.—Chemische Untersuchung der Mineralien des Bleibergs. 12mo. *Bonn*. 1830.
Kobell, Frantz von.—Charakteristik der Mineralien. *Nürnberg*, 1831.
——— Tafeln zur Bestimmung der Mineralien, etc. 4to. *Munich*, 1833. 3d edit., 1838.
——— same, translated by R. C. Campbell, and forming part of Griffin's Sci. Miscellany. 50 pp. 8vo. *Glasgow*, 1841.
Grundzuge der Mineralogie. 348 pp. 8vo. mit 4 lith. *Nurnberg*, 1838.
Hessel.—Crystallometrie. *Leipzig*, 1831.
Kupffer.—Handbuch der rechnenden Kristallonomie. 4to. 14 pl. *St. Petersburg*, 1831.
Karsten, Dr. C. J. B.—System der Mineralogie geschichtlich, statistisch, théoretisch und technisch. 5 vols. 8vo. and royal folio atlas, containing 51 plates, *Berlin*, 1831.
Walchner.—Handbuch der Gesammte Mineralogie. 1104 pp. 8vo. *Carlsruhe*, 1832.
Presl, M. K. B.—Anleitung zum Selbststudium der Oryctognosie. 3vo. *Prague*, 1833.
Catullo.—Elementi de Mineralogia applicata alla medicina e alla farmacia. 2 vols. 8vo. *Padua*, 1833.
Rose, M. Gustav.—Elemente der Krystallographie. 8vo. 10 pl. *Berlin*, 1833; also 2d edit. 1838.
Uhde.—Versuch einer genetischen Entwickelung, &c. *A Philosophical Essay on the Mechanical Laws of Crystallization*. 8vo. 4 pl. *Brême*, 1833.
Prestel, A. E.—Anleitung zur perspective Entworfung, &c. *On the Perspective projection of Crystalline forms*. 8vo. pl. *Göttingen*, 1833.
Allan, Robert.—A Manual of Mineralogy. 350 pp. 8vo. *Edinburgh*, 1834.
Suckow, M. G.—Grundriss der Mineralogie. 8vo. *Darmstadt*, 1834.
Plattner, C. F.—Probirkurst mit dem Löthrore. 1 vol. 8vo. 354 pp. with plates. *Leipzig*, 1835.
Berthier.—Traité des Essais, par la Voie Sèche. 2 vols. *Paris*.
Richard, A.—Précis élémentaire de Minéralogie. 8vo. pl. *Paris*, 1835.

Necker.—Le regne minéral ramené aux méthodes de l' histoire naturelle. 2 vols. in 8vo. of above 400 pages each. *Paris*, 1835.
Thomson, Thomas.—Geology and Mineralogy, forming the third portion, or the 4th and 5th volumes of his System of Chemistry. 2 vols. 8vo. *London*, 1835.
Kurr.—Grundzuge der ökonom-techischen Mineralogie. 8vo. 1836.
Hochsteller.—Populäre Mineralogie. 12 pl. 8vo. 1836.
Levy, A.—Description of a Collection of Minerals made by H. Heuland. 3 vols. with an atlas of 33 pl. 1837.
V. Leonhard, K. C.—Naturgeschichte des Mineralreich. 8vo. *Heidelberg*, 1839.
Quenstedt, Fr. A.—Methode der Krystallographie—a text-book for beginners. 412 pp with 7 pl. in 4to. *Tubingen*, 1840.
Fischer, S. C.—Handbuch der Mineralogie, 2 verm. Aufl. mit 2 táf. 8vo. *Vienna*, 1840.
Rammelsberg, C. F.—Handwörterbuch des Chemischen Theils der Mineralogie. 2 vols. 8vo. *Berlin*, 1841.
——— Erstes Supplement, &c. (1st supplement to the same.) 160 pp. 8vo. *Berlin*, 1843. To be continued biennially, under the title of *Repertorium des Chemischen Theils des Mineralogie.*
Huot, J. G. N.—Nouveau Manuel complet de Mineralogie, ou tableau de toutes les substances minerales. 2 vols. 18mo. *Paris*, 1841.
Landgrebe, G.—Ueber die Pseudomorphosen im Mineral-Reiche und verwandte Erscheinungen. 343 pp. 8vo. *Kassel.*
Fuchs.—Vorlesungen über Mineralogie.
Blum, J. R.—Die Pseudomorphen des Mineralreichs.
Mohs Fr.—Die ersten Begriffe der Mineralogie und Geognosie. 2 parts. 8vo. *Vienna*, 1842.

FOREIGN PERIODICALS.*

English.

Annals of Philosophy, by Thomson. 20 vols. *London*, 1813—1820.
——— new series, by R. Phillips. 12 vols. *London*, 1821—1826.
Journal of Science and the Arts, edited at the Royal Institution of Great Britain. *London*, 1816—1821.
Edinburgh Philosophical Journal, by Brewster and Jameson. 14 vols. *Edinb.* 1819—1826.
Edinburgh New Philosophical Journal, by Jameson. Continued since 1826.
Edinburgh Journal of Science, by David Brewster. *Edinburgh*, 1821—1832, two series, 16 vols.
Philosophical Magazine, or Annals of Chemistry, &c. by Taylor and Phillips, 1827—1831. 9 vols. *London.*
London and Edinburgh Philosophical Magazine and Journal of Science, by Brewster, Taylor, and Phillips, [new and united series.] Continued since 1832. *London.*
Records of General Science, by R. D. Thomson, &c. *London*, 1835, 6. 4 vols.

French.

Annales de Chimie. 96 vols. *Paris*, 1789—1815.
Annales de Chimie et de Physique, by Gay-Lussac and Arago. *Paris.* Continued since 1816.
Annales des Mines. *Paris.* Continued since 1816.

German.

Berzelius—Jahresbericht über die Fortschritte der physischen Wissenschaften, aus dem Schwedischen übersetzt von C. Gmelin, and more lately by Wöhler. *Tübingen*, since 1822.
Crell, Chemische Annalen. 40 B. *Helmstädt* und *Leipzig*, 1784—1804.
Erdmann, (afterwards with Schweigger-Seidel, and of late with Marchand,) Journal für praktische Chemie. *Leipzig.* Since 1834.
Gehlen.—Journal für die Chemie, Physik und Mineralogie. 9 B. *Berlin*, 1806—1810.

* Those Journals only are here included, which are important for their Mineralogical information, and are referred to in the body of the Treatise. The list is taken mostly from Rammelsberg's Chemical Mineralogy.

Gilbert.—Annalen der Physik. 76 Bände. *Leipzig*, 1799—1824.
Glocker.—Mineralogische Jahreshefte. 1st B. *Nürnberg*. Part of 2d vol. 1837. Now continued.
Karsten (und v. Dechen)—Archiv für Mineralogie, Geognosie, Bergbau und Hüttenkunde. *Berlin*. Since 1829.
V. Leonhard.—Taschenbuch fur die Gesammte Mineralogie. 18 Bände. *Frankfurt*, a. M. 1807—1824. Zeitschrift für Mineralogie, 5 Bänd, 1825—1829.
V. Leonhard und Bronn.—Jahrbuch für Mineralogie, Geognosie, &c. 1830—1832. Neues Jahrbuch, since 1833. *Stuttgard*.
Poggendorf.—Annalen der Physik und Chemie. *Leipzig*, since 1824.
Schweigger.—Journal für Physik und Chemie, (later with Schweigger-Seidel,) 69 Bände. *Nürnberg*, *Halle*, 1811—1833.
Hoffmann.—Berg- und huttenmänsche Zeitung. Continued; now the third year.

SWEDISH.

Kongl. Vetenskaps Academiens Handlingar. 8vo. *Stockholm*.
Afhandlingar i Fysik, Kemi och Mineralogi, utgifne af Hisinger och Berzelius. 6 Bde. *Stockholm*, 1806—1816.
Arsberättelse om Framsteg i Kemi och Mineralogie af Jac. Berzelius. Issued annually since 1821.
Verhandlungen der Kaiserlich-Russischen Mineralogischen Gesellschaft zu *St. Petersburg*. Now issued.

AMERICAN.

B. Silliman.—Mineralogy and Geology of New Haven, in a statistical account of the city of New Haven, by Pres. Timothy Dwight, published by the Connecticut Academy of Arts and Sciences. pp. 5—15. 8vo. *New Haven*, 1811.
*A. Aikin.—Manual of Mineralogy. 12mo. *Philadelphia*, 1815.
*Wm. Phillips.—Outlines of Mineralogy and Geology. 12mo. *New York*, 1817.
*——— Elementary Introduction to the Knowledge of Mineralogy, with notes and additions on American Articles, by Samuel L. Mitchill. 12mo. *New York*, 1818.
Parker Cleaveland.—Elementary Treatise on Mineralogy and Geology. 670 pp. 8vo. *Boston*, 1816; 2d edit. in 2 vols. 8vo. *Boston*, 1822.
James Freeman Dana, and Samuel L. Dana.—Outlines of the Mineralogy and Geology of Boston and its environs, with a Geological Map. 108 pp. 8vo. *Boston*, 1818.
*Thomas Thomson.—System of Chemistry, in 4 vols. 8vo., the 3d containing a Treatise on Mineralogy. Edited by Thomas Cooper, from the 5th London edition. *Philadelphia*, 1818.
Henry R. Schoolcraft.—A view of the Lead Mines of Missouri, including observations on the Mineralogy, Geology, Geography, &c. of Missouri and Arkansaw, and other portions of the Western Country. 2 plates. 300 pp. 8vo. *New York*, 1819.
Chemical Exercises in the Laboratory of the College of Physicians and Surgeons, by the pupils in the Laboratory under the direction of W. J. Macneven. 20 pp. 8vo. *New York*, 1819. Contains analyses of Dolomite from Kingsbridge, and Sulphate of Barytes from Scoharie, by T. & E. Gaillard, and S. S. Gasque, of South Carolina, and J. Emmett, of New York.
Thaddeus M. Harris.—The Natural History of the Bible, or a description of all the quadrupeds, birds, fishes, precious stones, &c., mentioned in the Bible. 476 pp. 8vo. *Boston*, 1820.
*Delvalle Lowry.—Conversations on Mineralogy and Geology. *Philadelphia*, 1822.
Webster.—Catalogue of Minerals in the State of New York. 12mo. *Albany*, 1824.
Frederick Hall.—Catalogue of Minerals found in the State of Vermont, and in the adjacent States. 44 pp. 8vo. *Hartford*, 1824.
M. A. Webster.—A Catalogue of Minerals which have been found in the State of New York. 32 pp. 12mo. *Albany*, 1824.

* Reprinted foreign works are indicated by an asterisk.

Samuel Robinson.—Catalogue of American Minerals with their localities, arranged in the order of the States. 8vo. 316 pp. *Boston*, 1825.

Ebenezer Emmons.—Manual of Mineralogy and Geology. 230 pp. 12mo. *Albany*, 1826; 2d edit. 299 pp. 12mo. *Albany*, 1832.

J. L. Comstock.—Elements of Mineralogy, adapted to the use of Schools and private students. lxxvi and 338 pp. 8vo. *Boston*, 1827; 3d ed. 12mo. 1841.

James Macauley.—A sketch of the Geology and Mineralogy of the State of New York. pp. 281—362, in a work entitled, "The Natural, Statistical, and Civil History of the State of New York, by James Macauley." 3 vols. 8vo. *New York*, 1829.

Ebenezer Baldwin.—Annals of Yale College, in New Haven, Connecticut. 8vo. *New Haven*, 1831. Contains a sketch of the Geology and Mineralogy of the vicinity of Yale College.

Proposals of the Phenix Mining Company, with a statement of the History and Character of their Mines in Granby, Conn. 30 pp. 8vo. *New York*, 1831.

C. T. Jackson and Francis Alger.—Remarks on the Mineralogy of Nova Scotia. 1 pl. 115 pp. 8vo. *Cambridge, Mass.*, 1832.

C. Andres Del Rio.—Elementos de Oryctognosia. 8vo. *Philadelphia*, 1832.

Charles Upham Shepard.—Treatise on Mineralogy. 1st part, one vol. 12mo. *New Haven*, 1832. 2d part consisting of descriptions of the species, and tables illustrative of their Natural and Chemical affinities. 2 vols. 12mo. with 500 wood cuts. *New Haven*, 1835.

Jane Kilby Welsh.—Familiar lessons in Mineralogy and Geology, designed for the use of young persons and Lyceums. 2 vols. 12mo. *Boston*, 1833.

Edward Hitchcock.—Report on the Geology, Mineralogy, Botany, and Zoology of Massachusetts, made and published by order of that State. 700 pp. 8vo. *Amherst*, 1833.

William W. Mather.—Sketch of the Geology and Mineralogy of New London and Windham Counties, in Connecticut. 36 pp. 8vo. with a map. *Norwich*, 1834.

N. F. Moore.—Ancient Mineralogy, or an Inquiry respecting Mineral Substances mentioned by the Ancients. 192 pp. 12mo. *New York*, 1834.

Jacob Porter.—Topographical Description and Historical Sketch of Plainfield, in Massachusetts. 44 pp. 8vo. *Greenfield*, 1834.

*J. M. Moffatt.—Mineralogy and Crystallography; pp. 236—298 of the Scientific Class Book. Reprinted with additions from the London edition, by Walter R. Johnson. 12mo. *Philadelphia*, 1836.

This work. 1st edition, 8vo. 596 pp. *New Haven*, 1837.

Abraham Gesner.—Remarks on the Geology and Mineralogy of Nova Scotia. 8vo. 277 pp. *Halifax*, 1837.

Lewis Feuchtwanger.—Treatise on Gems. 8vo. *New York*, 1838.

*Joshua Trimmer.—Practical Geology and Mineralogy, with instructions for the qualitative analysis of Minerals. 527 pp. 8vo. *Philadelphia*, 1842.

C. U. Shepard.—Report on the Mineralogy of Connecticut. 1 vol. 188 pp. 8vo. *New Haven*, 1837. Contains valuable notices of numerous minerals and mineral localities.

E. Hitchcock.—Geology of Massachusetts; 830 pp. 4to. in 2 vols. *Amherst* and *Northampton*. Contains interesting notices of the Massachusetts minerals and mineral localities, with a description of the proposed species Lincolnite, (p. 662,) and analyses of limestones, iron ores, marls, green sand, &c.

Lewis C. Beck.—Mineralogy of New York; 536 pp. 4to. with numerous lithographs and figures of crystals. *Albany*, 1842. A very complete treatise on the minerals of the State, with analyses of several species, and the new species Hudsonite proposed, (p. 405.

E. Emmons, L. Vanuxem, W. W. Mather, and J. Hall.—4 vols. in 4to. constituting, each separate Geological Reports on different sections of the State of New York. *Albany* 1842, 1843, 1844. Contain notices of numerous localities, with analyses of marls, &c

H. D. Rogers.—Report on the Geology of New Jersey. 300 pp. 8vo. *Philadelphia*, 1840. Contains numerous notices of localities, with analyses of green sand, &c.

J. C. Booth.—Memoir on the Geological Survey of the State of Delaware. 118 pp. 8vo. *Dover*, 1841. Contains analyses of green sand, &c.

C. T. Jackson.—Annual Reports (three) on the Geology of Maine—1836, 1837, 1839. *Boston*. Contain notices of numerous localities, with analyses of iron ores, limestones, &c.—Report on New Hampshire: contains analyses of the beryl of Acworth, albite of Alstead, brown tourmaline of Orford, description and analysis of the new mineral chlorophyllite, crystallography of Danaite, and the oxyd of tin of Jackson, N. H.; also analyses of iron ores, limestone, &c., with notices of numerous localities.—Report on Rhode Island: contains notices of a few localities, with a description and analysis of the new species Masonite.

The Annual Reports of the States of Pennsylvania, Virginia, Maryland, Ohio, Tennessee, Indiana, and Wisconsin, contain a few noticesof localities; the last, by D. D. Owen, an interesting account of the lead and copper region of Wisconsin.

ARTICLES IN AMERICAN JOURNALS.

Columbian Magazine, for 1788. *Philadelphia.*
B.—On the Ores and Fossils of America. Vol. II. pp. 153, 208, &c. with several plates.

The Medical Repository, edited by Samuel L. Mitchill and Edward Miller. 8vo. *New York*, 1798—1812. New series, 1812—1823.

VOL. I.—1798.
Samuel L. Mitchill.—A Sketch of the Mineralogical History of the State of New York, pp. 279, 431.

VOL. II.—1799.
Formation of the American Mineralogical Society, p. 105.
S. L. M.—A new variety of argillaceous iron ore, p. 205.

VOL. III.—1800.
Adamantine Spar and Basaltes, near Philadelphia, p. 202.
Thomas P. Smith.—On Crystallization, p. 253.
Samuel L. Mitchill.—A Sketch of the Mineralogical History of the State of New York, p. 235. Continued from Vol. I. p. 452.

VOL. IV.—1801.
Molybdæna in American granite, p. 419.

VOL. VI.—1803.
Rev. David Warden.—Observations on the Natural History of the village of Kinderhook and its vicinity, p. 4.

VOL. VII.—1804.
Lead, Iron, and Tin Mines in the Western Country, p. 306.
Native Gold discovered in North Carolina, p. 307.
Barytes discovered in New Jersey, p. 427.

VOL. VIII.—1805.
Disclosures in Mineralogy, from specimens brought to Dr. Mitchill, p. 81.
Place where the Ore of Columbium was found, p. 437.

VOL. IX.—1816.
Lead Mine in Pennsylvania, on Perkiomen Creek, p. 112.
Samuel Akerly.—Mineralogical description of the country near Wall-kill and the Shawangunk Mountains, in New York, p. 324.

VOL. XI.—1808.
American Ore of Titanium, p. 69.
Gibbs's Collection of Minerals, p. 213.
Fluate of Lime and Oxyd of Manganese in the State of New York, p. 441.

VOL. XII.—1809.
Mineralogical Notices of Onondaga, N. Y., p. 89.
Discovery of Minerals in New Jersey, p. 195.
Gideon C. Forsyth.—Geological, Topographical, and Medical information concerning the Eastern part of Ohio, p. 350.
S. P. Hildreth.—A concise description of Marietta, in the State of Ohio, with an enumeration of some vegetable and mineral productions in its neighborhood, p. 358.

VOL. XIII.—1810.
David B. Warden.—Analysis of the Stone of the Fejee Islands, employed by the Savages to make their axes, p. 75.
——— Analysis of Sulphate of Lime of Onondaga, N. Y., p. 76.
Lead in a metallic state, discovered in a spruce spar, p. 82.
Notice of the formation of a Mineralogical and Metallurgical Institution at Boston, p. 194.

Vol. XIV.—1811.
Fall of a Meteoric Stone in June, 1809, in Lat. 30° 58′, N., Long. 70° 25′, W. p. 178.
David B. Warden.—Description and Analysis of the Meteoric Stone which fell at Weston, Ct. Dec. 14, 1807, p. 194.
Fall of a Meteoric Stone in North Carolina, Jan. 1810, p. 390.

Vol. XV.—1812.
Quartz crystallized around Lead, p. 85.

New Series, conducted by S. L. Mitchill, Felix Pascalis, and Samuel Akerly.

Vol. I.—1813.
F. Aigster.—Minerals in the vicinity of Pittsburg, Penn., p. 211.

Vol. II.—1815.
Hauy on American Mineralogy, p. 86.
G. G. Sibley.—Description of great salt plains near the sources of the Arkansaw river, in Louisiana, p. 405.

Vol. III.—1817.
Minerals and Plants found at the Lead Mines in the Missouri Territory, p. 135.

Vol. IV.—1818.
Native Copper of North America, 101.

The American Medical and Philosophical Register, edited by David Hosack and John W. Francis. 8vo. *New York*, 1810—1814.

Vol. II.—1812.
Brackenridge.—An account of the Minerals of Louisiana, p. 33.

Vol. III.—1813.
David B. Warden.—Description and Analysis of the Meteoric Stones that fell at Weston, Conn., in 1807, p. 413.

American Mineralogical Journal, conducted by Archibald Bruce, M. D. 8vo. *New York*, 1810.

Vol. I.—1810.
S. L. Mitchill, M. D.—Descriptive Catalogue of Minerals found in the interior of the State of New York, p. 1.
Col. Gibbs.—Observations on the Fraconia Iron Works, p. 5.
——— Mineralogical notice respecting the West River Mountain, Connecticut River, p. 19.
——— Iron Works at Vergennes, Vt., p. 80.
——— Mass of Iron from Louisiana, p. 218.
W. Meade, M. D.—Description and Analysis of an Ore of Lead, p. 7.
——— Mineralogical Notice respecting Elastic Marble from Massachusetts, p. 93.
——— Description of several newly discovered Ores of Lead from Northampton, Mass., p. 149.
George Chilton.—Chemical Examination of Heavy Spar from New Jersey, p. 16.
Archibald Bruce, M. D.—On Native Magnesia from New Jersey, p. 26.
——— Description and Chemical Examination of an Ore of Zinc from New Jersey, p. 96.
——— Notice respecting American Fluates of Lime, p. 32.
——— On some of the Ores of Titanium found in the United States, p. 233.
S. Godon.—Phosphate of Lime and Phosphate of Lead from Pennsylvania, p. 30.
Charles J. Wister.—Description of Melanite from Pennsylvania, and Amber from New Jersey, p. 31.
Benjamin Silliman.—Description of the Lead Mines near Northampton, Mass., p. 63.
——— Mineralogical and Geological Observations on New Haven and its vicinity, p. 139.
B. ——— On the powers of the Compound Blowpipe, and its action on several of the mineral species, p. 199.
Benjamin S. Barton, M. D.—Notice of Fluate of Lime from Virginia, p. 79.
James Cutbush.—On the Blue Earth of New Jersey, p. 86.

Samuel Brown, M. D.—Description of a Nitre Cave on Crooked Creek, Kentucky, p. 100.
Iron, and Manufactures of Iron, p. 114; Copper and Brass, p. 116; Manufactures of Lead, p. 117.
Indicolite at Goshen, Mass., p. 123.
Mass of Malleable Iron from the Red River, p. 124; Zircon at Trenton, N. J., p. 124.
Solomon W. Conrad.—Zircon of Trenton, N. J., with an Engraving, p. 427.
Samuel Akerly, M. D.—On the Geology and Mineralogy of the Island of New York, p. 191.
William Smith.—On the Saint Maurice Iron Works, near the town of Three Rivers, in Lower Canada, p. 198.
Robert Gilmore.—A descriptive Catalogue of Minerals occurring in the vicinity of Baltimore, p. 221.
Hayden.—On the Chromate of Iron found near Baltimore, p. 243.
Beryl in the United States, p. 263.
Minerals from Tennessee, p. 265.

Literary and Philosophical Repertory, 8vo. *Middlebury, Vt.*, 1813—1815.

Vol. I.—1813.
On Coccolite near Lake Champlain, pp. 379—382.

American Journal of Science and Arts, conducted by Benjamin Silliman, Prof. Chem. and Min. &c. in Yale College. 8vo. *New Haven*, 1819; after 1838, with B. Silliman, Jr.

Vol. I.—1819.
Locality of Fluor Spar and Galena, near Shawneetown, Illinois, p. 52.
James Pierce, Esq.—Carbonate of Magnesia of Hoboken, N. J., pp. 54 and 142.
Native Copper near New Haven, p. 55.
John H. Kain.—Remarks on the Mineralogy and Geology of the Northwestern part of Virginia and the Eastern part of Tennessee, p. 60.
Edward Hitchcock.—Geology and Mineralogy of a section of Massachusetts, on the Connecticut River, with a part of New Hampshire and Vermont, pp. 106 and 436.
W. B. Stilson.—Geology and Mineralogy of a part of Indiana, p. 131.
New Localities of Agate, Chalcedony, Chabasie, Stilbite, Analcime, Titanium, Prehnite, &c., p. 134.
Amos Eaton.—Account of the Strata and Minerals at the Southampton Lead Mine, p. 136.
Samuel Brown, M. D.—Singular substance found with the Native Nitre of Kentucky and of Africa, p. 146.
Rev. Elias Cornelius.—Geology and Mineralogy, &c. of parts of Virginia, Tennessee, and the Alabama and Mississippi Territories, pp. 214 and 317.
Caleb Atwater.—Notice of the Geology, Mineralogy, Botany, &c. of Belmont Co., Ohio, p. 226.
F. C. Schæffer.—Localities of Agate, Apatite, Brown Hæmatite, Carbonate of Magnesia, Jasper, Malachite, Talc, Graphite, Quartz, Barytes, Tourmaline, &c., p. 236.
Localities of Minerals.—Molybdenite in Shutesbury, Mass. and Pettipaug, Conn., Limpid Quartz, in West Canada Creek, N. Y.; Plumbago, in Cornwall, Conn.; Minerals of the Blue Ridge; Sulphate of Barytes, at Southington, Conn.; Beryl, at Haddam; Limpid Gypsum, near Cayuga Lake; Amianthus, in the Anthracite of Rhode Island; Red Pyroxene, near Baltimore, pp. 237—244.
Discovery of American Tungsten and Tellurium, pp. 312, 316, and 405.
Prof. Dewey.—Mineralogy and Geology of the vicinity of Williams College, Williamstown, Mass., p. 337.
Col. George Gibbs.—Tourmalines and other Minerals of Chesterfield and Goshen, Mass., p. 346.
John P. Brace.—Minerals of the Gneiss Range of Litchfield Co., Conn., p. 351.
J. L. Comstock.—Discovery of American Cinnabar and Native Lead.
J. Torrey, M. D.—Staurotide on the Island of New York, p. 435.

Vol. II.—1820.
B. F. Stickney.—American Cinnabar and Native Lead, p. 170.
Fibrous Sulphate of Barytes, from Carlisle, N. Y., p. 173; Siderographite, p. 176.
James Pierce.—Geology, Mineralogy, &c. of the Secondary Region of New York and New Jersey, p. 182.

Benjamin Silliman.—Sketches of a Tour in the counties of New Haven and Litchfield, Conn., with notices of the Geology, Mineralogy, &c., p. 201.
Prof. Dewey.—Localities of Serpentine, Bitter Spar, Tremolite, Mica, &c., in Massachusetts, p. 236.
Amos Eaton.—Localities of White Augite, Sappar, Plumbago, and Adularia, in Connecticut and Massachusetts, p. 238.
J. W. Webster, M. D.—Minerals at Haddam, and other places in Connecticut, p. 239.
D. B. Douglass.—Crystallized Heavy Spar on the Islands at the west end of Lake Erie, p. 241.
J. F. Dana, M. D.—Tremolite, Plumbago, and Epidote, in New Hampshire, p. 241.
Rev. Mr. Schæffer.—Epidote, var. Pistacite, in Dutchess Co., N. Y., p. 241.
Prof. Dewey.—Notice of a Mineral, supposed to be Wavellite, p. 249.
M. P. Berthier.—Analysis of the New Jersey Ores of Zinc, (from the Ann. des Mines,) p. 319.
Prof. Jacob Green.—On the Crystallization of Snow, p. 337.
Sulphate of Magnesia, 16 miles west of Albany, p. 375.

Vol. III.—1821.
John Dickson.—Mineralogy and Geology of parts of South and North Carolina, p. 1.
G. Troost, M. D.—On the Amber of Maryland, p. 8.
F. Hall.—On the Ores of Iron and Manganese, p. 56.
J. A. Allen, M. D.—Minerals in the vicinity of Brattleboro', Vt., p. 76.
Henry R. Schoolcraft.—On the Native Copper of Lake Superior, &c., p. 207.
——— Geological character of the Missouri Lead Mine region, p. 248.
T. D Porter, M. D.—Mineralogical notice of some parts of North and South Carolina; Locality of Zircon, &c., p. 227.
D. Dickson.—Locality of Corundum, p. 229.
Localities of Micaceous Iron Ore, p. 232. Limpid Quartz from Fairfield, N. Y., p. 233. Agaric Mineral, Vermont, p. 234. Fluor Spar on the Genesee river, N. Y., p. 235. Fetid Dolomite and American Wavellite, p. 239. Alum in decomposed Mica Slate, p. 240. Garnet Rock, Reading, Conn., p. 241. Virginia and Illinois Fluor Spar, p. 243. Manganese and Sulphate of Lime in Virginia, p. 245. Alum Stone and other Minerals in Ohio, p. 246.
J. J. Bigsby, M. D.—Geological and Mineralogical Observations of the Northwestern portion of Lake Huron, p. 254.
Benjamin Silliman.—Argentiferous Galena from Huntington, and another Lead Ore from Bethlem, Conn., with miscellaneous observations on Lead Ores, p. 173.
John Locke, M. D.—Account of the Copperas Mines and Manufactory in Stafford, Vt., p. 326.
Sulphate of Strontian, Mouse Island, Lake Erie, p. 363. Epidote at Nahant, Mass., p. 364. Fluor Spar of Genesee, N. Y., p. 367. Fluor Spar of Illinois, p. 367.

Vol. IV.—1822.
Z. Cist.—On the Wilkesbarre Anthracite, p. 1.
——— New Locality of Manganese, p. 38.
Thomas Nuttall.—On the Serpentine of Hoboken and the Minerals it contains; Nemalite, Marmolite, p. 16.
F. Hall.—Iron Mines and Manufactures in Vermont, p. 23.
John H. Steel.—New Locality of Chrysoberyl at Saratoga, N. Y., p. 37.
T. Seal.—New Locality of Beryl, Chester Co., Penn., p. 39.
Benjamin Silliman.—Notices of Minerals and Rocks, chiefly in Berkshire, Mass., and contiguous to the waters of the upper Hudson, and the Lakes George and Champlain, p. 40.
Fluor Spar, near Providence, R. I., p. 50. Fluor Spar in Tennessee, p. 51. Native Yellow Oxyd of Tungsten, at Lane's Mine, Conn., p. 52. Columbite, at Haddam, p. 52. Chrysoberyl of Haddam, p. 52. Plumbago, from North Carolina, p. 53. Micaceous Iron, from near Northampton, Mass., p. 53. Foliated Talc, Actinolite, Windham, Vt., and other places, p. 54. Rose Quartz, of Southbury, Conn.; Crystallized Chlorite from the Falls of the Schuylkill; Black Oxyd of Manganese, p. 54. Rutile, at Lane's Mine, Huntington. Conn., p. 55.
Massive Yellow Oxyd of Tungsten, p. 187. Fluor Spar, at Putney, Vt., p. 188.
T. Cooper, M. D.—On Volcanoes and Volcanic substances, p. 205.
Prof. Dewey.—Crystallized Steatite, Middlefield, Vt.; Zoisite, Wardsboro', Vt.; Silico-calcareous Oxyd of Titanium, pp. 274—277.
D. W. Barton.—On the Virginia Fluor Spar, p 277.

Joseph Delafield.—Sulphate of Strontian of Lake Erie and Detroit river, p. 279.
J. J. Bigsby, M. D.—Sulphate of Strontian of Lake Erie.
H. H. Hayden.—Ore of Cobalt and Manganese, p. 283.
T. H. Webb.—Minerals in the vicinity of Providence, R. I., p. 284.
Henry Seybert.—Analysis of Molybdenite, p. 320.
G. T. Bowen.—Analysis of the Lake Erie Sulphate of Strontian, &c. p. 324.

Vol. V.—1822.
James Pierce.—Geology and Mineralogy, &c. of the Highlands of New York and New Jersey, p. 26.
Benjamin Silliman.—Localities of Minerals, pp. 39, 254.
James G. Percival.—Locality of Sulphate of Barytes and other minerals in Berlin, Conn., p. 42.
Henry Seybert.—Analysis of Tabular Spar, Pyroxene, and Colophonite, of Lake Champlain, p. 113.
——— Analysis of Maclureite, p. 336.
——— Remarks on Chondrodite, p. 366.
George T. Bowen.—Analysis of the Calcareous Oxyd of Tungsten, from Huntington, Conn., p. 118.
——— Analysis of the Pyroxene in the vicinity of New Haven, p. 334.
John S. Bigsby.—Outline of the Mineralogy and Geology of Malbay, L. C., p. 205.
John Torrey.—Description and Analysis of a new ore of Zinc, p. 235
Thomas Nuttall.—Remarks on the Minerals of Paterson and Sparta, N. J., p. 239.
Prof. Dewey.—Notice of Crystallized Steatite, and of Ores of Iron and Manganese, p. 249.
Denison Olmsted.—Rocks and Minerals collected in North Carolina, p. 257.
Catalogue of Minerals presented to the Amer. Geol. Soc., p. 267.
Green Zinc Ore of Ancram, N. J.; Stilbite in the Highlands opposite New York, p. 399. Siliceous Oxyd of Zinc; Franklinite of New Jersey, p. 400. Molybdenite; Zircon, from North Carolina; Native Copper, Phosphate of Copper, Carbonate of Copper, Red Oxyd of Copper, at Summerville Copper Mine, N. J., p. 401. Jeffersonite, Automolite, Sphene, p. 402. Cyanite, p. 403.

Vol. VI.—1823.
Edward Hitchcock.—Geology, Mineralogy, &c. of Connecticut, pp. 1 and 201.
Henry Seybert.—Analysis of a Manganesian Garnet, with a notice of Boracic Acid in Tourmalines, p. 15'.
——— Protest in relation to the discovery of Fluoric Acid in Chondrodite, p. 188.
Thomas Nuttall.—Reply to Mr. Seybert, p. 171.
Major Delafield.—American Andalusite, p. 176.
James Freeman Dana.—Localities of Minerals in New Hampshire, p. 245.
Steuben Taylor.—Localities of Minerals in Rhode Island, p. 245.
Jacob Porter.—Various Localities of Minerals, p. 246.
J. Stuart.—Localities of a few Minerals in Vermont, p. 249.
W. Langstaff, M. D.—Minerals found in Gneiss, near Cold Spring Landing, p. 250.
Prof. Keating.—On the Cadmia of Ancram, p. 180.
Prof. Dewey.—Analysis of Argentine and Crystallized Steatite, p. 333.

Vol. VII.—1824.
Edward Hitchcock.—Geology, Mineralogy, &c. of the Connecticut, p. 1.
H. R. Schoolcraft.—Copper Mine on Lake Superior, p. 43.
Wm. Meade.—Localities of Minerals in Connecticut and Massachusetts, p. 49.
Thomas H. Webb.—Fluor Spar, Tourmalines, Talc, p. 54.
H. N. Fenn.—Coal, Gypsum, and Barytes, New York, p. 56.
Jacob Porter.—Localities of Minerals in Massachusetts, pp. 56 and 252.
Dr. Cutbush.—Localities of Minerals near West Point, p. 57.
Frederick Hall.—Localities of Minerals in Vermont, p. 58.
Prof. Dewey.—Additional Notice of Argentine, p. 248.
Charles U. Shepard.—Yenite of Rhode Island, and Green Feldspar of Chesterfield, Mass., p. 251.
Steuben Taylor, M. D.—Miscellaneous Localities of Minerals, pp. 56 and 252.
Ebenezer Emmons.—Miscellaneous Localities of Minerals, p. 254.

Vol. VIII.—1824.
C. Dewey.—Geology and Mineralogy of a part of Massachusetts, and parts of the adjoining States, p. 1.

J. Bigsby.—List of Minerals and Organic Remains occurring in the Canadas, p. 60.
New Localities of Sahlite, Augite, Ceylanite, &c., p. 88.
Henry Seybert.—Analysis of the Chrysoberyls of Haddam, Conn., and Brazil, p. 105.
G. T. Bowen.—Description and Analysis of Sillimanite, p. 113.
——— Analysis of a Siliceous Hydrate of Copper from New Jersey, with a notice of the Localities of Spodumene in the United States, p. 178.
Malleable Iron of Louisiana, p. 218.
Miscellaneous Localities of Minerals, pp. 225—236.
C. A. Lee.—Notice of the Ancram Lead Mine, p. 247.
——— Geology and Mineralogy of Salisbury, Conn., p. 252.
Formation of Crystals in Geodes, p. 282.
Henry Seybert.—Analysis of a Hydrate of Iron, p. 298.
——— Analysis of Melanite from Sussex Co., N. J., p. 300.

Vol. IX.—1825.
Denison Olmsted.—On the Gold Mines of North Carolina, p. 5.
Edward Hitchcock.—Localities of several Minerals in Massachusetts, p. 20.
Localities of Minerals; Phillipstown, Putnam Co., N. Y.; Cold Spring, Pittsfield, Mass.; Dalton, Mass.; Chatham, N. Y.; Schaghticoke, near Hoosac river, N. Y., &c., pp. 39—44.
G. W. Carpenter.—Localities of Minerals in Pennsylvania, p. 45.
J. G. and J. B. Anthony.—Minerals in Rhode Island, p. 46.
C. U. Shepard.—Scapolite and Pinite, &c. in Massachusetts, p. 47.
——— Anthophyllite at Branford, Conn.; Quartz Pseudomorphous of Lead, at Southampton Lead Mine.
Samuel Robinson, M. D.—Miscellaneous Localities of Minerals, p. 49.
Jacob Porter.—Miscellaneous Localities of Minerals, p. 54.
Lead Veins of Massachusetts, p. 166.
Phosphate of Lime from Williamsburgh, p. 174.
Topaz, p. 180.
Samuel Fowler, M. D.—Spinel, &c., at Warwick, Orange Co., N. Y., p. 242.
Carpenter and Spackman—Miscellaneous Localities of Minerals, p. 245.
Globules of Water in Amethyst, from Bristol R. I., p. 246.
Ebenezer Emmons, M. D.—Carbonate of Manganese, Cummington, Mass., p. 249.
G. W. Benedict.—Miscellaneous Localities of Minerals, p. 250.
Emerson Davis.—Miscellaneous Localities of Minerals, p. 252.
West Point Minerals, p. 402.

Vol. X.—1826.
Lardner Vanuxem.—Experiments on Anthracite, Plumbago, &c., p. 102.
Localities of Minerals in Rhode Island, Massachusetts, Connecticut, and at Paris, Maine, pp. 10—19, and 218—227.
Emerson Davis.—Notice of Rocks and Minerals in Westfield, Mass., p. 213.

Vol. XI.—1826.
Topaz, at Monroe, Conn., p. 192.

Vol. XII.—1827.
Native Iron Ore from Canaan, Conn., p. 154.
Charles U. Shepard.—Antimony, Automolite, and Pleonaste, at Haddam, Conn., with other Localities of Minerals.
——— Comparison of the Crystallographic characters of Kyanite and Sillimanite, p. 159.
C. A. Lee.—Minerals at Canaan and Cornwall, Conn, p. 169.
Minerals at Carlisle, Mass., p. 176.
Native Gold discovered at New Fane, Vt., p. 177.
Francis Alger.—Mineralogy of Nova Scotia, p. 227.
A. Nash.—Lead Mines of Hampshire Co., Mass., and the Geology and Mineralogy of that region, p. 238.
Wm. Meade.—Analogy of the Minerals of the North of Europe and of America, p. 303.
Calamine in Missouri, p. 376; Cobalt in Missouri—Localities of a few Minerals, p. 378.
Troost and Le Sueur.—Lead Ores of Missouri, p. 379.

Vol. XIII.—1828.
A. A. Hayes.—Localities of Minerals in Vermont, p. 195.
C. U. Shepard.—Phosphate of Manganese in Connecticut; New Locality of Tabular Spar, &c., p. 196.

C. U. Shepard.—Measurements of Crystals of Zircon from Buncombe Co., N. C., p. 392.
C. E. Rothe.—Remarks on the Gold mines of North Carolina, p. 201.

Vol. XIV.—1828.
G. W. Carpenter.—Mineralogy of Chester Co., with an account of some of the Minerals of Delaware, Maryland, and other localities, p. 1.
J. Finch.—Geology and Mineralogy of the country near Westchester, Penn., p. 15.
Native Iron slightly arseniuretted, p. 176. Vermont Manganese, p. 190.
Edward Hitchcock.—Miscellaneous notices of Mineral Localities, with Geological remarks, p. 215.
C. T. Jackson and F. Alger.—Mineralogy and Geology of a part of Nova Scotia, p. 305.

Vol. XV.—1829.
G. W. Carpenter.—On the Salt and the Salt Springs of the United States, p. 1.
Stephen Smith.—Salt Springs and Salt of Salina, N. Y., p. 6.
C. T. Jackson and F. Alger.—Mineralogy and Geology of a part of Nova Scotia, pp. 132 and 201.
Amos Eaton.—Gases, Acid, and Salts, on and near the Erie Canal, p. 233.

Vol. XVI.—1829.
E. Mitchell.—Geology of the Gold region of North Carolina, p. 1.
J. C. Keeney.—Novaculite in Georgia, p. 185.
J. Finch.—Bronzite, at Amity, in Orange Co., N. Y., p. 185.
C. U. Shepard.—On Native Soda Alum in Milo, p. 203.
——— Columbite in Massachusetts, p. 217.
Tin in Massachusetts, p. 198.
Gold Mines of North Carolina, p. 360.
Fibrous Gypsum of Onondaga Co., N. Y., p. 377. Chalcedony, p. 375.

Vol. XVII.—1830.
T. G. Clemson.—Analysis of an Iron Ore from the environs of Baltimore, p. 42.
C. U. Shepard.—Crystallized Native Terrestrial Iron, Ferro-silicate of Manganese, and other American Minerals, p. 140.
——— Mineralogical Journey in the Northern parts of New England, p. 353.
Wm. Meade, M. D.—New Locality of Zircon at *Deer Hill*, in the mountainous part of the town of Cornwall, N. Y., p. 196.

Vol. XVIII.—1830.
Philip P. Tyson.—Localities of Minerals near Baltimore: with an Appendix by C. U. Shepard, p. 78.
Lieut. Baddeley.—Sulphate of Strontian, of Kingston, U. C., p. 104.
C. U. Shepard.—Mineralogical Journal into New Hampshire, Maine, &c., pp. 126 and 289.
M. Wachtmeister.—Analysis of a new Mineral from Hoboken, p. 167.
J. Finch.—Arragonite near New Brunswick, p. 197.
Lieut. W. W. Mather.—Xanthite and its Crystalline Form, with a notice of Mineral Localities, p. 359.
Plumbago of Sturbridge, Mass., p. 377.

Vol. XIX.—1831.
J. Finch.—Mineralogy and Geology of St. Lawrence Co., N. Y., p. 220.
C. U. Shepard.—Spathic Iron of New Milford, and the Iron Works of Salisbury, Conn., p. 311.
Analysis of the supposed Anthophyllite of New York, p. 359.

Vol. XX.—1831.
A. A. Hayes.—A singular instance of Crystallization, p. 128.
J. Porter.—Localities of Minerals, p. 170.

Vol. XXI.—1832.
A. A. Hayes.—Cobalt and Nickel of the Chatham Mine, Conn., p. 195.
Samuel Fowler, M. D.—Account of the Sapphire and other Minerals in Newton Township, Sussex Co., N. J., p. 319.
C. U. Shepard.—Mineralogy and Geology of the Counties of Orange, N. Y., and Sussex, N. J., p. 321.
C... ...re of Stafford, Vt., p. 383.

Vol XXII—1832.
Mineralogy and Geology of Nova Scotia, p 167.
C U Shepard—Datholite and Iolite in Connecticut, p 289
Statistics of Iron in the United States, p. 179

Vol XXIII—1833.
Judge Jacob Peck.—Geology and Mineralogy of the Mining District of Georgia, p. 1.
B Silliman—A Fountain of Petroleum in Allegany Co., N Y, p. 97.

Vol XXIV—1833
Wm. Phillips—On the Georgia Gold Mines, p. 1.
W. W. Mather—Reduction of Silver Ores, with a notice of the principal Silver Mines of Mexico and South America, p. 213
H H Hayden—Description of the Bare Hills near Baltimore, p. 349.
Analysis of *Fer Titané* of Baltimore, Md, p 386.
Analysis of Danaite, a supposed new Ore of Iron and Cobalt, p 386

Vol XXV—1834
C T Jackson, M D.—Description of a supposed new Mineral species, (Lederente,) p. 78
A A Hayes—Analysis of Lederente, p 78.
Ten Days in Ohio, from the Diary of a Naturalist, p 217.
J. B. Crawe, M D and A Gray, M D.—Mineralogy of a portion of Jefferson and St Lawrence Counties, p 316

Vol XXVII—1835
Ebenezer Emmons—Strontianite found in the United States, p. 182
C U Shepard—Additional Remarks on Strontianite, p. 183
——— Microlite, a new Mineral species, p 361
——— Strontianite of Schoharie, with a notice of the Limestone Cavern in the same place, p 363
Large mass of Native Copper, p 381 Soapstone of Middlefield, p 382.

Vol XXVIII—1835
John Gebhard—Geology and Mineralogy of Schoharie, N Y., p 172.
James D Dana.—A new System of Crystallographic Symbols, p 250.
Schoharie Minerals, p 381 Granite at Chesterfield, Mass, p 382
Chromate of Iron in Townsend, Vt, p 383

Vol XXIX—1836
S. P Hildreth, M D—On the Bituminous Coal Deposits and accompanying Strata of the Valley of the Ohio, p 1.

Vol XXX—1836
James D Dana—On the Formation of Compound Crystals, p 275
Ebenezer Emmons—A Scientific Excursion into Nova Scotia, p. 330.
Analysis of Chabasie, p. 366
Analysis of Albite of Chesterfield, p. 381.

Vol XXXI—1837.
S P Hildreth.—Miscellaneous Observations made during a Tour to the Falls of the Cuyahoga, near Lake Erie, p. 1.
Emmonite, a supposed new American Mineral, p. 171
Dr Thomson—Analysis of North American Minerals, p 172.
L. Feuchtwanger—Breithaupt's New Specific Gravities of Minerals, p 268.

Vol XXXII. No I—1837.
Benjamin Silliman—Remarks on some of the Gold Mines, and on parts of the Gold Region of Virginia, founded on personal observations made in the months of August and September, 1836, p. 98
Franklin L. Smith.—Notice of some facts connected with the Gold of a portion of North Carolina, p. 130.
James D. Dana.—On the identity of the Torrelite of Thomson with Columbite, p. 149.
Charles U Shepard.—Description of Edwardsite, a new Mineral, p. 162.
O. P. Hubbard.—Geological and Mineralogical Notices, p. 230 (Calc Spar, Coccolite, and Tabular Spar, at Boonville, N. Y., p. 234.)
M. F. Maury, U. S. N.—On the Gold Veins of the United States' Mine near Fredericksburgh, Va., p. 325.

C. U. Shepard.—Chemical Examination of Microlite, p. 338.
——— Eremite, a new Mineral species, p. 341.

VOL. XXXIII.—1838.
James D. Dana.—On the Drawing of figures of Crystals, p. 30.
——— Crystallographic Examination of Eremite, p. 70.
Crystallographic Examination of Edwardsite, p. 202.
F. Hall.—Notice of Oriental Minerals, p. 249.
B. Silliman.—Additional notices of Oriental Minerals, p. 255.
Meteoric Iron, p. 257.
J. W. Foster.—Locality of Iolite, Molybdenite, Mica, and Garnet, p. 399.

VOL. XXXIV.—1838.
O. P. Hubbard.—Mineralogy and Geology of the White Mountains, p. 105.
C. U. Shepard.—Geology of Upper Illinois, p. 134.
——— Calstronbarite, a new Mineral species, p. 161.
Tourmaline at Orford, N. H., p. 204.
C. U. Shepard.—Warwickite, a new Mineral species, p. 313.
——— Topaz at Middletown, Conn., and Phenakite in Massachusetts, p. 329.
C. T. Jackson.—Analysis of Meteoric Iron from Claiborne, Alabama, p. 332.
Gold in Georgia, p. 397.
Columbite and Tin Ore at Beverly, Mass., p. 402.

VOL. XXXV.
C. U. Shepard.—Danburite, a new Mineral species, p. 137.
W. L. Atlee.—On certain Cavities in Quartz, p. 139.
Supposed new Mineral at Bolton, Mass., p. 178.
Locality of Crichtonite at Litchfield, Conn., and Stilbite, Chabazite, and other Minerals at Stonington, Conn., p. 179.
Crichtonite in Rhode Island, p. 180.
Notice of Feuchtwanger's Treatise on Gems, p. 189.
Green Feldspar and Galena, p. 192.
Analysis of Gmelinite or Hydrolite, p. 195.
Catlinite of Dr. Jackson, or Indian Pipestone, p. 388.
Marble and Serpentine in Vermont, p. 390.

VOL. XXXVI.—1839.
C. U. Shepard.—On Meteoric Iron from Buncombe Co., N. C., p. 81.
——— Analysis of Warwickite, p. 85.
Lewis C. Beck.—Notices of the Native Copper, Ores of Copper, and other Minerals, near New Brunswick, N. J., p. 107.
Volborthite, a new Mineral, p. 187.
Cause of the red color of Agates, p. 207.
Analysis of Native Iron from South Africa, p. 213.
Two new Cobalt Ores, p. 332.

VOL. XXXVII.—1839.
Cinnabar not found in Michigan, p. 185.
I. Bowring.—On the Boracic Acid Lagoons of Tuscany, p. 270.
Mineralogical and other Notices, from R. K. Porter's Travels in Georgia, Persia, Armenia, &c., p. 347.
Rose Mica Lepidolite, p. 361.
Dr. Berendt's Investigations on Amber, p. 365.
Beaumontite, a new Mineral, by Dr. Jackson, p. 398.

VOL. XXXVIII.—1840.
Thomas Taber.—Practical Remarks on Gems.
J. E. Teschemacher.—Minerals found at Milk Row, in Charlestown, Mass.
C. T. Jackson.—Analysis of Serpentine Marble from Vermont, and notice of a Crenate of Copper, p. 198.
Reports on the Shells and Minerals presented by Dr. Brinckerhoff to the New York Lyceum of Natural History, p. 198.
J. C. Booth and M. C. Lea.—Analysis of a Chromic Iron Ore from the Island of Cuba, p. 243.
G. Troost.—Analysis and Description of a Meteorite from Tennessee, p. 250.
Analysis of Anthracite and Iron Ore, by Prof. Johnson, p. 382.
A. A. Hayes.—Iodate of Soda and Potash, and a new Sulphate of Alumina from Iquique, S. A., p. 410.

Vol. XXXIX.—1840.
Notice of Prof. Johnson's Report on the Coal Field of Carbon Creek, p. 137.
F. Alger.—Notice of Minerals from New Holland.
C. U. Shepard.—Identity of Edwardsite with Monazite, p. 249.
——— Lederite, a supposed new Mineral, p. 357.
A. A. Hayes.—Native Nitrate of Soda from Peru, p. 375.

Vol. XL.—1841.
Wm. Oland Bourne.—A Locality of Zeolites at Bergen, N. J., p. 69.
Elaterite, or Fossil Caoutchouc, p. 215.
Gold in France, p. 216.
C. U. Shepard.—On Native and Meteoric iron, p. 366.
Notice of a new variety of Beryl, p. 401.

Vol. XLI.
Discovery in Virginia of the regular Mineral Salt Formation, p. 214.
J. C. Booth.—Analysis of various Ores of Lead, Silver, Copper, Zinc, Iron, &c., from King's Mine, Davidson Co., N. C., p. 348.
C. U. Shepard.—On two decomposed varieties of Iolite, p. 354.

Vol. XLII.
John Locke.—Alabaster in the Mammoth Cave of Kentucky, p. 206.
Dr. L. Feuchtwanger.—Notices of Thrombolite, Allomorphite, Anauxite, Polyhydrite, Serbian, Violan, Tombacite, Hepatic Blende, Volborthite, and Gigantolite, p. 386.
J. H. Blake.—Coal Mines in Cuba, p. 388.

Vol. XLIII.
J. E. Teschemacher and A. A. Hayes.—On the Identity of Pyrochlore with the Microlite of Prof. Shepard, p. 33.
J. T. Hodge.—On the Wisconsin and Missouri Lead Region, p. 35.
C. U. Shepard.—On the Non-Identity of Microlite and Pyrochlore, p. 116.
W. B. Rogers.—Tin in Virginia, and Blende, Calamine, Galena, White Lead Ore, Minium and Yellow Oxyd of Lead, in Wythe Co., Va., p. 168.
C. U. Shepard.—On Washingtonite, a new species; also, notices of Euclase in Connecticut, and on the supposed Phenacite of Goshen, and Calstronbaryte of Scoharie, N. Y., p. 364.

Vol. XLIV.
J. H. Blake.—Geological and Miscellaneous Notices of the Province of Tarapaca, p. 1.
L. C. Beck.—Notices of some Trappean Minerals found in New Jersey and New York, p. 54.
C. B. Hayden.—On the Rock Salt and Salines of the Holston, Va., p. 17.
R. I. Murchison.—On the Salt Steppe south of Orenburg, and on a remarkable Freezing Cavern, p. 206.
Mineralogical Systems, p. 214.
J. T. Plummer.—Suburban Geology of Richmond, Indiana, p. 281.

Vol. XLV.
C. U. Shepard.—Phosphate of Lime in the Virginia Meteorite, p. 102.
E. Hitchcock.—On Native Copper in drift in Massachusetts, and the occurrence of Yttrocerite in the State, p. 331.
H. Houghton.—Copper, Silver, and Zeolites in Michigan, p. 332.
J. D. Dana.—Identity of Eremite with Monazite, p. 402.

Vol. XLVI. No. I.
Review of Beck's Mineralogy of New York, p. 25.
A. A. Hayes.—Re-examination of Microlite and Pyrochlore, p. 158.
B. Silliman, Jr.—New Locality of Sillimanite and Monazite, p. 207.
Gold in the Ural, p. 207.
Periclase, a new Mineral, p. 212.

Boston Journal of Philosophy and the Arts. 8vo. 1824—6.

Vol. I.—1824.
J. W. Webster.—Locality of Rubellite and Lepidolite at Paris, Maine, p. 190.
——— Chemical Examination of a Fragment of a Meteor which fell in Maine, August, 1823, and of Green Feldspar from Beverly, Mass., p. 386.
——— New Localities of Minerals in Massachusetts—Zircon, Green Feldspar, Apatite, Andalusite, Spodumene, Cleavelandite, p. 599.

Vol. II.—1825.
J. W. Webster.—Remarks on the Geology of Boston and its vicinity, p. 277.
C. U. Shepard.—Notice of several new Localities of Minerals in the Counties of Hampshire, Berkshire, and Franklin, Mass., p. 607.

Vol. III.—1826.
H. A. S. Dearborn.—Sketch of the Mineralogy of Gay Head and of Bird Island, p. 588.
Notice of the Discovery and Geological Situation of the Native Gold of Vermont, p. 592.
J. W. W.—Notice of the Mineralogy of Nova Scotia, and of several new Localities of American Minerals, p. 594.

Monthly American Journal of Geology and Natural Science, conducted by G. W. Featherstonhaugh. 8vo. 1831—1832. *Philadelphia.*

A Description of a Crystal of Native Copper, p. 318.
Minerals and Metallic Veins, p. 481.
Peter A. Browne.—On the Rocks in the vicinity of Philadelphia, p. 517.

American Philosophical Transactions. 4to. *Philadelphia*, 1771—

Vol. VI.—1809.
Benjamin Silliman and James L. Kingsley.—On the Meteoric Stones which fell in Connecticut, December 14, 1807, p. 323.

Vol. I.—*New Series.*—1818.
Thomas Cooper.—Analysis of the Blue Iron Earth of New Jersey, p. 193.

Vol. II.—*New Series.*—1825.
G. Troost.—Description and Chemical Analysis of the Retinasphaltum, discovered at Cape Sable, Magothy river, Maryland, p. 110.
——— A new Crystalline form of the Yenite of Rhode Island, p. 478.
Henry Seybert.—Analyses of the Chrysoberyls of Haddam and Brazil, p. 116.

Memoirs of the American Academy. 4to. *Cambridge*, 1785—

Vol. II.—1793.
R. M. Causlin.—An account of an earthy substance found near the Falls of Niagara, and vulgarly called the Spray of the Falls, together with some accounts of the Falls, p. 17.

Vol. III.—1809.
S. Godon.—Mineralogical Observations made in the environs of Boston, in the years 1807 and 1808.

Vol. I.—*New Series.*—1833.
Charles T. Jackson and Francis Alger.—Remarks on the Mineralogy and Geology of Nova Scotia, p. 217.

Vol. V.—1837.
A. del Rio.—On the Crystals developed in Vermiculite by heat, p. 137.

Memoirs of the Connecticut Academy of Arts and Sciences. 8vo. *New Haven.*

Vol. I.—1813.
Benjamin Silliman.—Sketch of the Mineralogy of the town of New Haven, p. 83.

Journal of the Academy of Natural Sciences of Philadelphia. 8vo. *Philadelphia*, 1817—

Vol. I.—1817, 1818.
Isaac Lea.—An account of Minerals at present known to exist in the vicinity of Philadelphia, p. 462.

Vol. II.—1821, 1822.
G. Troost, M. D.—Descriptions of some new Crystalline forms of Phosphate of Lime and Zircon, p. 55.
——— Description of a new Crystalline form of Quartz, p. 212.
——— Description of some Crystals of Sulphate of Strontian from Lake Erie, p. 300.

Lardner Vanuxem.—Analysis of the Blue Iron Earth of New Jersey, p. 82.
——— On two veins of Pyroxene in Granite, p. 146.
——— Description and Analysis of Tabular Spar from the vicinity of Willsborough, Lake Champlain, p. 182.
——— New Locality of Automolite, p. 249.
——— and W. H. Keating.—On the Geology and Mineralogy of Franklin, in Sussex Co., N. J., p. 277.
W. H. Keating.—Description and Analyses of Jeffersonite, p. 194.
——— On the Cadmia found at the Ancram Iron Works, Columbia Co., N. Y., p. 289.
Henry Seybert.—Analysis of some American Minerals; a variety of Amphibole, Ferruginous Oxydulated Copper Ore, and a Green Phosphate of Lime, p. 139.
Augustus E. Jessup.—Geological and Mineralogical notice of a portion of the North-eastern part of the State of New York, p. 185.

Vol. III.—1823, 1824.
L. Vanuxem.—Description and Analysis of the Zirconite of Buncombe Co. N. C., p. 59.
——— Description and Analysis of a Lamellar Pyroxene, p. 68.
——— Identity of Marmolite and Serpentine, p. 129.
G. Troost, M. D.—Pyroxene of the United States, and descriptions of some new varieties of its Crystalline forms, p. 105.
——— Notice of Yenite of Rhode Island, and other American Minerals, p. 222.
——— Description of Petalite from Lake Ontario, p. 234.
——— A new Crystalline form of Chrysoberyl, p. 293.
George T. Bowen.—Analysis of an Ore of Copper from New Jersey, p. 295.
——— Description and Analysis of Sillimanite, a new Mineral, p. 375.
Notices of American Spodumene, p. 284.

Vol. IV.—1824, 1825.
Lardner Vanuxem and W. H. Keating.—Observations on the following Minerals found at Franklin, Sussex Co., New Jersey: Jeffersonite var. of Pyroxene, Franklinite, Red Zinc Ore, Calamine, and Electric Calamine, p. 3.
G. Troost, M. D.—Description of a new Crystalline form of Andalusite (?), p. 122.
——— Observations on the Zinc Ores of Franklin and Sterling, Sussex Co., N. J., p. 220.

Vol. V.—1825—1827.
L. Vanuxem.—Experiments on Anthracite, Plumbago, &c., p. 17.
G. Troost, M. D.—A new Crystalline form of Apophyllite, Laumonite, and Amphibole, and of a variety of Pearlstone, p. 51.
E. James, M. D.—Remarks on the Limestones of the Mississippi Lead Mines, p. 375.

Vol. VI.—1829, 1830.
L. Vanuxem.—Analysis of Cyanite and Fibrolite, and their union in one species under the name of Disthene, p. 41.
S. G. Morton, M. D.—Analysis of Tabular Spar from Bucks Co., Penn., with a notice of various Minerals from the same locality, p. 50.
S. W. Conrad.—Notice of a Mineral which approaches the Bildstein of Werner; with remarks on the connection of Bildstein with Feldspar, p. 102.

Vol. VII. Part I.—1834.
H. D. Rogers and A. D. Bache.—Analyses of some of the Coals of Pennsylvania, p. 158.

Annals of the Lyceum of Natural History of New York. 8vo. *New York,* 1824—

Vol. I.—1824, 1825.
Joseph Delafield.—Notice of New Localities of Minerals along the North Coast of Lake Superior, &c., p. 79.
James Renwick.—Examination of a Mineral (Torrelite) from Andover Furnace, Sussex Co., N. J., p. 37.
John Torrey.—Notice of a Locality of Yenite in the United States, p. 51.
——— An account of the Columbite of Haddam, Conn., and several other North American Minerals, p. 89.
Joseph G. Totten.—Notes on new supports for Minerals subjected to the action of the common Blowpipe, p. 109.

Issachar Cozzens.—Examination of some Iron Ores from the Northern parts of the State of New York, p. 378.
H. R. Schoolcraft.—Remarks on Native Silver from Michigan, p. 247.
J. J. Bigsby.—Sketch of the Geology of Montreal, p. 198.
VOL. II.
James Freeman Dana.—Analysis of the Copper Ore of Franconia, New Hampshire, with remarks on Pyritous Copper, p. 253.

VOL. III.
Thos. Thomson.—Analyses of the following Minerals, principally American: Native Soda Alum, Bisilicate of Manganese, Silicate of Manganese, Ferro-Silicate of Manganese, Ferruginous Silicate of Manganese, Sesquisilicate of Manganese, Diphosphate of Iron, Arfwedsonite, Franklinite, Manganesian Iron Ore, Bucholzite, Nacrite, Xanthite, Phyllite, Hydrous Silicate of Magnesia, Bisilicate of Magnesia, Chondrodite, Gokumite, Idocrase, Brown Manganesian Garnet, Pipestone, Ekebergite, Fahlunite, Spinel, Ceylanite, Stilbite, Heulandite, Steinheilite, Harmotome, Thomsonite, Nuttallite, Arseniet of Antimony, Arsenical Pyrites., p. 9.

VOL. IV.—1837.
James D. Dana.—A new Mineralogical Nomenclature, p. 8.
J. Torrey.—Discovery of Vauquelinite in the United States, p. 76.

Contributions of the Maclurean Lyceum to the Arts and Sciences. 8vo. *Philadelphia,* 1827.

G. Troost, M. D.—On Pyroxene, pp. 51 and 61.

Transactions of the Geological Society of Pennsylvania. 8vo.

VOL. I.—1833—1835.
T. G. Clemson.—Analysis of the Copper Ore of Hunterdon Co., N. J., p. 167.
——— Examination and Analysis of the several Coals and Iron Ores of the coal field of Blossburg, p. 219.
——— Native Iron from Penn Yan, Yates Co., N. Y., p. 358.

Transactions of the Albany Institute. 8vo. *Albany,* 1831.

VOL. I.—1831.
G. W. Clinton.—Notice of the Graphite of Ticonderoga, p. 233.

Boston Journal of Natural History. 8vo. *Boston.*

VOL. I.—1834—1836.
Charles T. Jackson.—Chiastolite or Macle of Lancaster, p. 55.
——— Analysis of Chrysocolla from the Holquin Copper Mines, Cuba, p. 206.
——— Analysis of three varieties of Bituminous Coal, and one of Anthracite.

VOL. III.—1840, 1841.
A. A. Hayes.—Notice of Native Nitrate of Soda, containing Sulphate of Soda, Chloride of Sodium, Iodate of Soda, and Chloriodide of Sodium, p. 279.
F. Alger.—Notice o Minerals from New Holland, p. 306.

VOL. IV.—1842.
J. E. Teschemacher.—On the occurrence of the Phosphate of Uranium at the Tourmaline Locality of Chesterfield, Mass., p. 35.

Journal of the Essex County Natural History Society. 8vo.

VOL. I. No. II.—1839.
Wm. Prescott.—A Sketch of the Geology and Mineralogy of the Southern part of Essex Co., Mass.

Transactions of the Association of American Geologists. 1 vol. 8vo. 1840—1842.

L. C. Beck.—On Some Pseudomorphous Minerals of the State of New York, p. 24.
J. E. Teschemacher.—On the Oxyd of Tin of Chesterfield, Mass.

C. T. Jackson.—Description of the Tin Veins of Jackson, N. H., p. 316.
——— Remarks on Zinc, Lead, and Copper Ores of New Hampshire, p. 321.

Transactions of the Maryland Academy of Science and Literature. 8vo. *Baltimore.*

VOL. I. PART I.—1837.
P. T. Tyson.—A Descriptive Catalogue of the principal Minerals of the State of Maryland.

ADDENDA

Apatelite.—A sulphate of the peroxyd of iron from Mendon and Auteuil, peculiar in containing but little water. Composition, according to M. Meillet, Sulphuric acid 42·90, peroxyd of iron 53·30, and water 3·96=100·16, leading to the formula $2\dddot{F}^2\dddot{S}^3+3\dot{H}$. It occurs in small friable nodules, or balls, of a clear yellow color, disseminated in an argillaceous bed, associated with the plastic clay. It had been taken for hydrate of iron. (Ann. des Mines, 4e. ser. iii, 808.)

Bismuthic Galena.—The ore of bismuth occurring at the Lubec lead mines of Maine, has been chemically examined by A. A. Hayes, and found to be a bismuthic galena, or a mixed sulphuret of lead and bismuth. Physically it scarcely differs from fine-grained galena. (A. A. Hayes, in a private communication to the author.)

Branchite.—Branchite is a resinous substance, somewhat resembling Scheererite, from a deposit of brown coal in Tuscany. It is colorless and transparent, without smell or taste, and has a greasy feel. G.=1·00. It fuses at 167° F., and does not crystallize on cooling, in which respect it differs from Scheererite. (*Savi*, Leonh. und Bronn. N. Jarhb. 1842, p. 459.)

Cobalt Bloom and Cobalt Ochre.—Kersten finds that a cobalt bloom from a mine near Schneeberg, has part of the oxyd of cobalt replaced by lime: he obtained, on analysis, Arsenic acid 38·10, protoxyd of cobalt 29·19, lime 8·00, water 23·90. He suggests that it may be identical with the *Roselite* of Levy, (p. 273.) It occurs in small implanted globules of a deep rose red color, having a radiated structure and a drusy surface. The protoxyds of nickel and iron often replace, in the same manner, part of the oxyd of cobalt. The cobalt ochre, or arsenite of cobalt, (see p. 274,) from a mine near Schneeberg, afforded Kersten, Arsenous acid 51·00, arsenic acid 19·10, protoxyd of cobalt 16·60, protoxyd of iron 2·10, water 11·90, with a trace of oxyd of nickel and sulphuric acid. Kersten supposes both these salts to have proceeded from the decomposition of gray cobalt, but considers the cobalt bloom as a crystallization from a solution of arsenate of cobalt, while the ochre is merely the immediate result of the oxydation of the cobalt ore. (Pogg. lx, 251, 1843.)

Haydenite.—In the analysis of this mineral by B. Silliman, Jr., (p. 526,) the iron was estimated as protoxyd, from the excess found in the analysis, (103·355.) But Mr. Silliman states, (Silliman's Jour., xlvi,) that there is reason to believe that the *lime* might have been in excess; and allowing for this, and taking the iron as *peroxyd*, he deduces the formula $(\dot{C}a, \dot{M}g, \dot{K})\dddot{S}i+(\ddot{A}l, \ddot{F}e)\dddot{S}i^2+3\dot{H}$, which is identical with that given for some chabazites, (from Parsborough,) excepting half the proportion of water. (See page 559.)

Hydrous Pyrites, (*Wasserkies* of the Germans.)—Berzelius remarks that it is improbable that the water in this variety of pyrites is in chemical combination, as has been suggested by Glocker, (see p. 478.) It has not been observed crystallized. (Arsberät., 1843, p. 200.)

Iceland Minerals.—The following new species from Iceland are proposed by Forchhammer, in the Skand. Nat. Samm. i Stockholm, July, 1842. *Lime-Oligoclase*, (Havnefjordit, or Kalkoligoklas of Forchhammer,) occurs with pyroxene and titanic iron at Havnefjord. It is a colorless mineral, apparently oblique rhomboidal in its crystallization, consisting of Silica 61·22, alumina 23·32, peroxyd of iron 2·41, lime 8·82, magnesia 0·36, soda 2·56, with *a trace* of potash. *Krisuvigite* is an emerald green salt of copper, from

Krisuvig, consisting of Sulphuric acid 18·88, oxyd of copper 67·75, water 12·81, oxyd of iron and alumina 0·56. *Baulite* is a feldspathic volcanic rock, from Baulaberget, consisting of Silica 76·65, alumina 11·57, lime 0·05, magnesia 0·20, potash 3·26, soda 3·73, protoxyd of iron 0·63=99·09. G.=2·623. It is usually mixed with quartz. *Krablite* is a kind of pearlstone, occurring in the form of globules, of a red color, with a concentric structure and columnar fracture, imbedded in obsidian. G.=2·389. Composition, Silica 71·83, alumina 13·49, peroxyd of iron 4·40, lime 1·98, magnesia 0·17, soda 5·56, potash a *trace*=100·43. It is from Hrafntinnabruggr in Iceland. (Arsberät. af Berz., 1843, pp. 189—192.)

A Recent Iron-Zeolite.—This mineral forms incrustations two or three lines thick upon gneiss, in the pump-wells at the Himmelsfurst mine, near Freyberg. They have a fibrous or stellate fracture, and are strongly adherent to the rock. G.=2·28. H. above that of gypsum. Composition, Silica 18·98, peroxyd of manganese 25·01, peroxyd of iron 22·90, water 33·00=99·89. The waters of the mine holding sulphate of iron in solution, remaining for some time in contact with fluor spar and silica, become in some way charged with fluo-silicic acid; on reaching the air, the iron and manganese are superoxydized, and the salts deposited as a hydrous metallic silicate. (*Kersten*, J. f. pr. Chem. xxii, 1.)

Kammererite.—This new species, from Bissersk in Siberia, has been instituted by Nordenskiöld, and named in honor of the Mineralogist M. Kammerer. It occurs along with chromic iron, in six-sided prisms, having a perfect cleavage, and within, nearly the reddish violet color of lepidolite. G.=2·76. H.=2. Before the blowpipe it exfoliates a little, and gives out water, without melting even on the edges. Composition, according to Hartwall, Silica 37·0, alumina 14·2, oxyd of chrome 1·0, magnesia 31·5, lime 1·5, protoxyd of iron 1·5, water 13·0. Berzelius remarks that this mineral resembles the Hydrargillite of Rose, from Achmatowsk, (see p. 304 of this treatise,) and is also very near Kobell's pyrosclerite, (see p. 530.) (Act. Soc. Sci. Fen. i, 483; Arsberät., 1843, p. 193.)

Leonhardite.—Resembles Laumonite in most of its characters, and may be identical with it. The primary is given as an oblique rhombic prism, with M : M=96° 30′, and P : M=114° and 64°. H.=3—3·5. G.=2·25. Color white, or with a yellowish or brownish tinge. Whitens and crumbles on exposure like Laumonite. Composition, according to Delff and Babo, Silica 55·00, alumina 24·06, lime 10·50, water and loss 12·30. (Pogg. Ann. 1843.)

Monradite.—Monradite is allied, in composition, to picrosmine. It is a pale yellowish mineral, verging on red, with the hardness nearly of feldspar, a vitreous lustre, and the specific gravity 3·2673, occurring massive, but with one distinct and another imperfect cleavage, [illegible]
blowp[illegible]
tion, [illegible]
4·04. It is from Bergen in Norway. (*A. Erdmann*, K. V. Ac. H. 1842, p. 103.)

Native Gold.—Native gold has been observed in Tennessee by Prof. G. Troost, imbedded in laminated graphite, either in grains or thin leaves between the folia. (*G. Troost*, in a private communication to the author.)

Ores of Cerium and Yttrium.—In these ores, Mosander has lately discovered that the oxyd of cerium is associated with the oxyds of lanthanum and the new metal didymium; and the oxyd of yttrium with the oxyds of the new metals erbium and terbium. (Pogg. lx, 297, 311; 1843.)

Pyroxene.—Hochstetter has analyzed crystals of augite from Pico, one of the Azores, with the following result: Silica 50·40, protoxyd of iron 22·00, lime 21·10, magnesia 2·40, alumina 2·99, loss by ignition 0·30=99·19, which is near the variety Hedenbergite. Specific gravity=3·174. (J. für. pr. Chem. xxvii, 375.)

Sillimanite.—This mineral has lately been analyzed by A. A. Hayes, of Roxbury, with nearly the same result as obtained by Bowen. (Private communication to the author.)

Uranotantalite, (p. 438.)—The color of this mineral is velvet-black.

Vanadate of Lime.—This compound has been observed by Ficinus, disseminated in a specimen of pitchblende, the locality of which is not known. It has a brick red color, a foliated structure, and a bright shining lustre. The vanadium, which some analysts have detected in pitchblende, (see p. 439,) is supposed to have come from mixture with this hitherto unnoticed species. (J. f. pr. Chem. xxvi, 35.)

INDEX.

ERRATA.

Page 49, 3d line from top, for *centre*, read *acute*.
" 51, 3d line from top, for *left*, read *right*.
" 126, 20th line from bottom, before *to*, insert *belonging*.
" 214, among synonyms of Arsenous acid, for *Arsenikk-luthe*, read *Arsenik-bluthe*.
" 241, near bottom, for a, a′, a″, read a′, a″, a.
" 272, under Pyrosmalite, for G.= 3·81, read G.=3·081.
" 324, in analysis of Hydrous Mica, for *magnesia* 1·8, read *magnesia* 8·1.
" 339, 23d line from bottom, for *Laacher Lee*, read *Laacher See*
" 355, among the synonyms of Labradorite, for *Silicate*, read *Silicite*.
" 363, under Troostite, for G =3·011—3·031, read G =4·011—4·031.
" 386, near middle of page, for *C. P. Jackson*, read *C. T. Jackson*.
" 426, 14th and 15th lines from top, for *Kupperbluthe*, read *Kupferbluthe*, and for *Salenium*, read *Selenium*.

Page 443, in the analysis of Earthy Cobalt, for 99·45, read 19·45.
" 488, under Stromeyerite, for G =4·258, read 6·258.
" 522, 4th line from top, dele *the*, before *Bamle*.
" 538, 13th line from top, for *Willardsboro*, read *Wardsboro*.

" 552, in formula for Sulphurous Acid, for S, read S.
" 555, in formula of Retinalite, for ^{6}, read ^{1}.
" 556, in formula of Cummingtonite, for ^{3}, read 3; and in formula of Chrysolite, for 3, read ^{3}.

Page 557, in formula of Chloritoid, at bottom, for, —, before 9**H**, read +.

" 562, in formula of Basic Flucerine, for 3**C**c**H**, read 3**C**e**H**.
" 562, under Pyrorthite, insert after manganese, *coal and water;—a mechanical mixture*.

Page 585, 2d line from bottom, for *Birnsstein*, read *Bimsstein*.